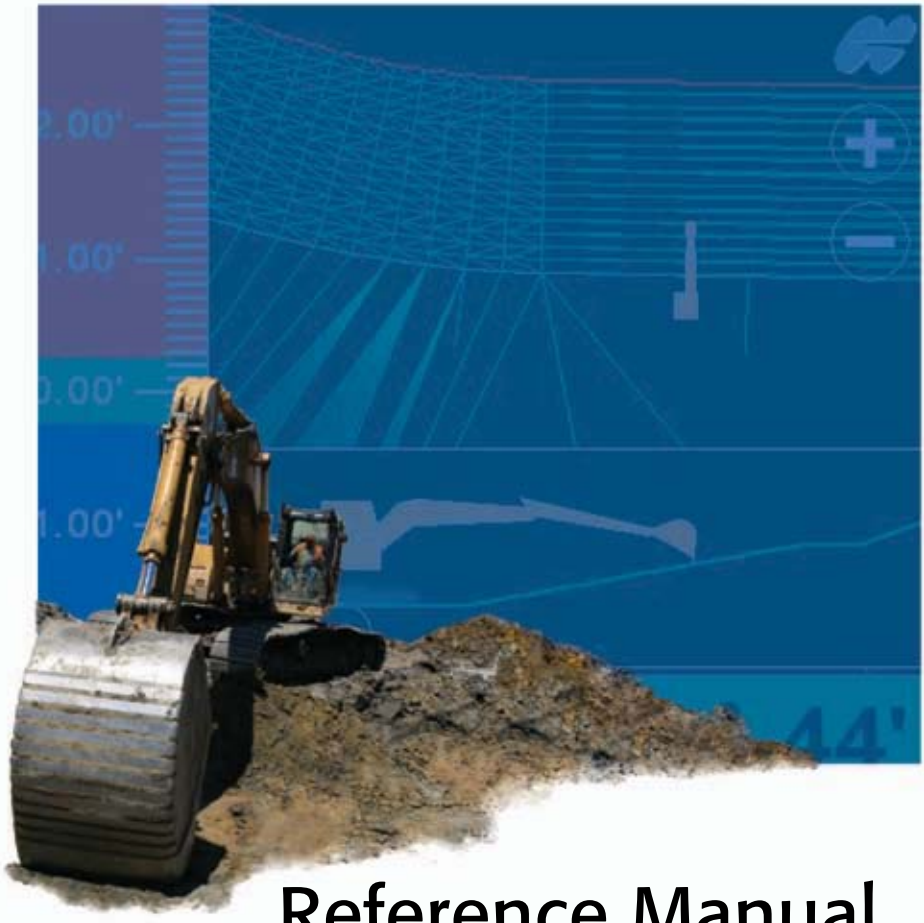
TOPCON

3Dxi

GPS Excavator Indicate Systems



Reference Manual

TOPCON
POSITIONING SYSTEMS

3Dxi
Reference Manual

Part Number 7010-0696
Rev. B

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Preface

This manual has been developed to provide machine operators or superintendents with information necessary to operate and maintain the TOPCON 3Dxi excavator system. Proper service and use is important for reliable operation of the equipment. The sections provided in this manual include information necessary for the correct operation, care, and troubleshooting of this product.

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Manual Conventions

This manual uses the following conventions:

Example	Description
File ▸ Exit	Press the **File** menu, then press **Exit**.
Enter	Press the button or key labeled **Enter**.
Machine files	Indicates the name of a dialog box or screen, or a tab within a dialog box or screen.
Name	Indicates a field or tab on a dialog box or screen.

Further information to note about the configuration, maintenance, or setup of a system.

	Supplementary information that can help you configure, maintain, or set up a system.
	Supplementary information that can have an affect on system operation, system performance, measurements, or personal safety.
	Notification that an action has the potential to adversely affect system operation, system performance, data integrity, or personal health.
	Notification that an action *will* result in system damage, loss of data, loss of warranty, or personal injury.
	Under no circumstances should this action be performed.

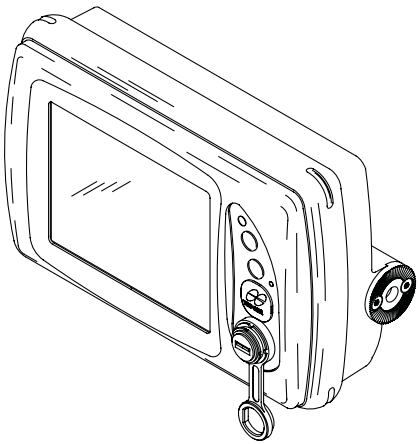
What's New with 3Dxi

This chapter briefly describes new features and functions for the 3Dxi system.

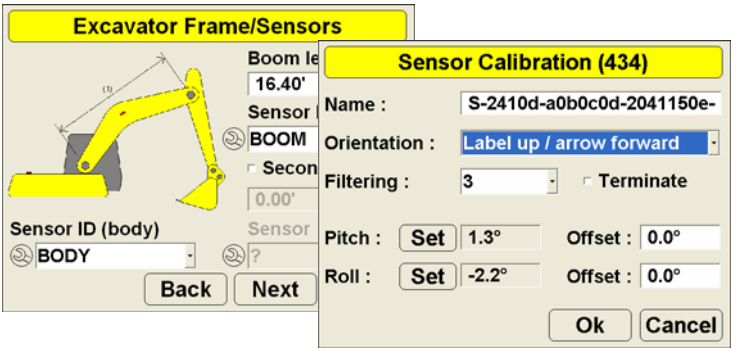
⇨ The GX-60 control box is Topcon's interface between the operator and the 3Dxi system components. The 3DMC application software continues to provide viewable, accurate, and up-to-date jobsite control.

Features of the GX-60 control box include USB device support for USB storage devices or other device connected via USB. Integrated serial ports in the back and updated cable configurations provide low-profile, efficient connections to the system's components.

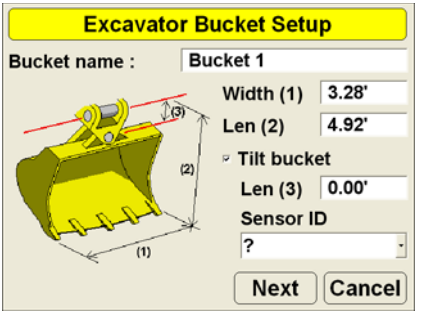
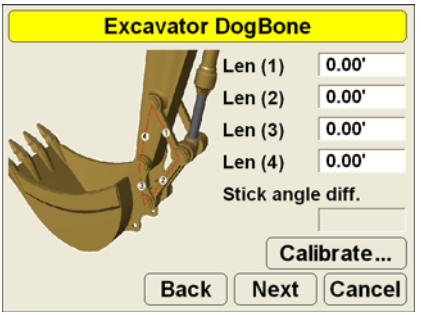
For more information on the GX-60 control box, see "GX-60 Control Box" on page 1-3 and "GX-60 Control Box Features" on page 2-1.

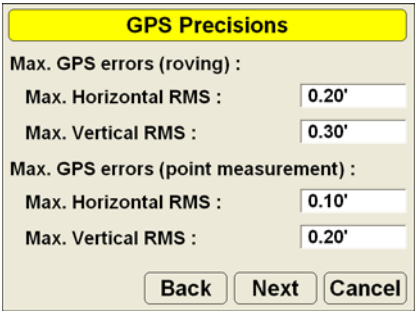
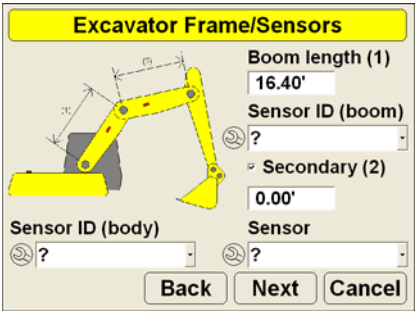


- 3DMC is used to configure and calibrate the TS-1 sensors. See Appendix A for details applicable to creating a machine setup file. Refer to the *3Dxi Installation and Calibration Manual* for specific details.



- New machine information and configurations are available when creating a machine setup file. See "Create a 3Dxi Machine Configuration" on page 4-14 for more information.

Tilt buckets can now be configured.	
TS-1 placement on the dog-bone is now supported.	

GPS precision can be entered.	
Measurements for a jointed boom can be entered.	

- A grade indicator can be displayed on the right of the screen. See "Right Window View" on page 5-6 for details.
- The number of decimal places to display on-screen can be selected. See "Display Units Options" on page 5-22 for details.
- The receiver and/or RTK positioning can be reset using 3DMC. See "Viewing Receiver Information and Resetting the Receiver/RTK" on page 5-25 for details.

Notes:

Introduction

Topcon's 3Dxi™ for excavator systems is a productive, positioning system to use for 3D grade and slope control. 3Dxi is a three-dimensional, GPS system using four to five accelerometers and GPS technology to precisely locate the cutting edge of the machine, in real time, anywhere on the construction site, reducing the need for costly stakeout and survey.

3Dxi Components

The 3Dxi package consists of the following components:

- Machine Components:
  - GX-60 control box
  - Cables
  - Mounting hardware
  - TS-1 tilt sensors
  - Radio antenna
- GPS Components:
  - Two MC-A1 machine antennas
  - Machine MC-2.5 receiver box (includes radio modem)
  - Base station kit
- Optional Components:
  - Pocket-3D
  - Supporting accessories and software/hardware
  - Additional options

Figure 1-1 on page 1-2 illustrates the components on an excavator.

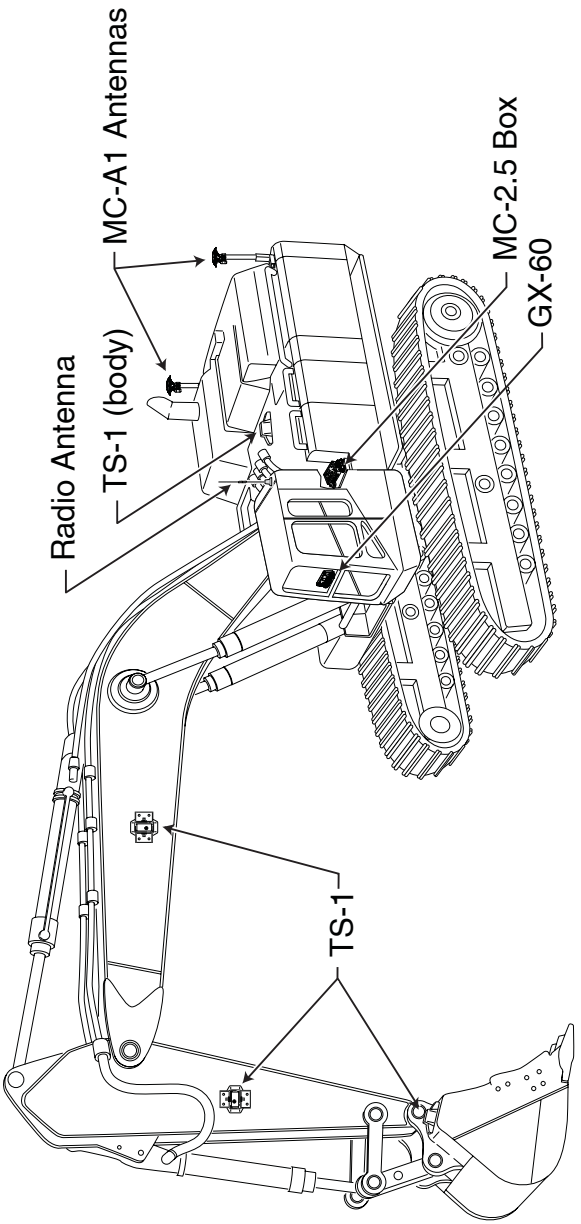


Figure 1-1. 3Dxi Excavator System Components

GX-60 Control Box

The GX-60 control box (Figure 1-2) is the operator's interface, as well as the primary control, for the 3Dxi excavator components. The GX-60 control box with the installed 3DMC application software calculates three-dimensional, stakeless GPS positions.

- The high-resolution, bright touch screen display easily adapts to a variety of machine applications, providing the operator with easy-to-view graphical information.
- A mount secures the control box in the cab. The clamps provide easy attachment at the beginning of the day and easy removal for storage at the end of the day.
- All cables attach in the back and remove easily with quick-disconnect connectors.

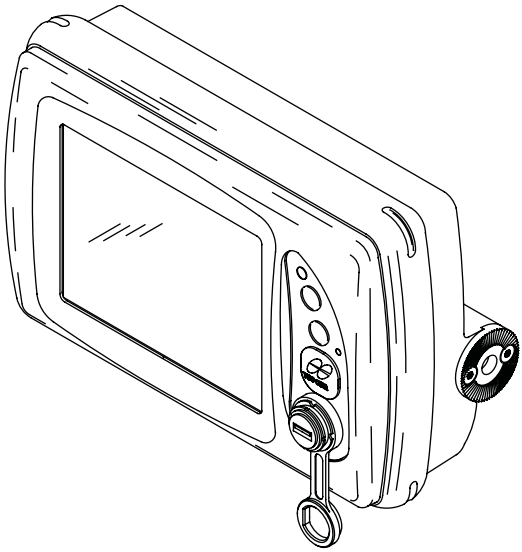


Figure 1-2. GX-60 Control Box

GPS MC-2.5 Receiver Box

The GPS MC-2.5 Receiver Box (Figure 1-3) attaches to the machine with shock isolated magnetic mounts. The MC-2.5 Receiver Box can be easily removed at the end of each day for storage, and contains no manual adjustment.

The MC-2.5 Receiver Box combines Topcon's GPS receiver module and a radio module into a single, rugged housing. When used in conjunction with a Base Transmitter, this combination provides the GX-60 control box and operator with Real Time Kinematic (RTK) measurements. The control box processes these real time measurements to compute grade and graphical mapping information.

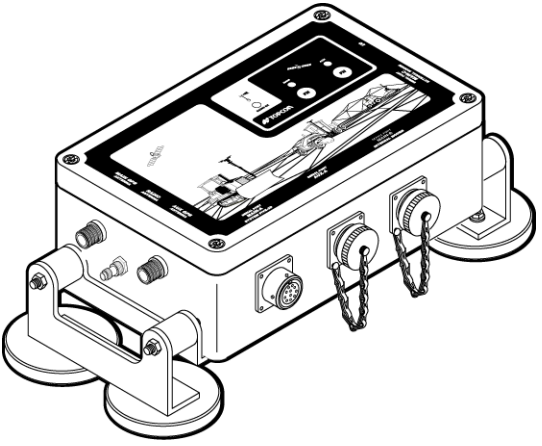


Figure 1-3. MC-2.5 Rover GPS Receiver Box

TS-1 Tilt Sensors

The TS-1 tilt sensors (Figure 1-4) provide lateral and longitudinal angle measurements, regardless of the object's position in space. Each of the four sensors accurately measures the position of the body, boom, stick and bucket, sending this angle data to the GX-60 to provide precise positioning. Using 3DMC software, each sensor is configured and calibrated for its specific location on the excavator.

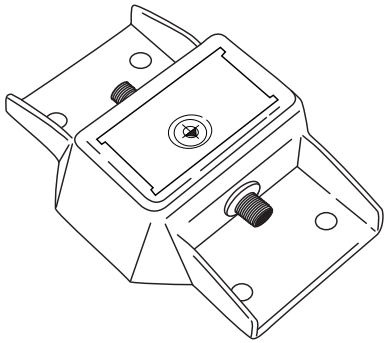


Figure 1-4. TS-1 Tilt Sensor

Machine GPS MC-A1 Antenna

In GPS indicate applications, the machine's GPS MC-A1 Antenna (Figure 1-5) affixes to the top of the mounting pole installed on the body of the machine. The antenna should be removed at the end of each day for storage.

The rugged antenna is specially designed to perform on earth-moving machinery; the 3Dxi system uses two MC-A1 antennas.

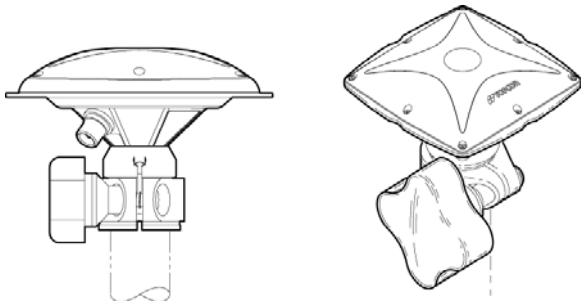


Figure 1-5. MC-A1 GPS Antenna

Base Station Kit

The Base Station Kit (Figure 1-6) sends position corrections to the machines or survey Rover. As a remote system, an unlimited number of machine or Rovers can use the Base Station. The kit includes Topcon's Legacy-E+ receiver, PG-A1 antenna, radio modem, tribrach, cables, and a hard carrying case. In spread spectrum applications, the HiPer Lite or HiPer Lite+ replaces the Legacy-E+ and PG-A1 antenna, providing simple, one button, cable free operation.

The type of options on the Base Station kit can be customized based on individual needs; some kits support GPS+ positioning with RTK measurement and others support normal GPS positioning with RTK measurement. If used with a portable foundation, like a tripod, daily setup and daily height measurements are required.

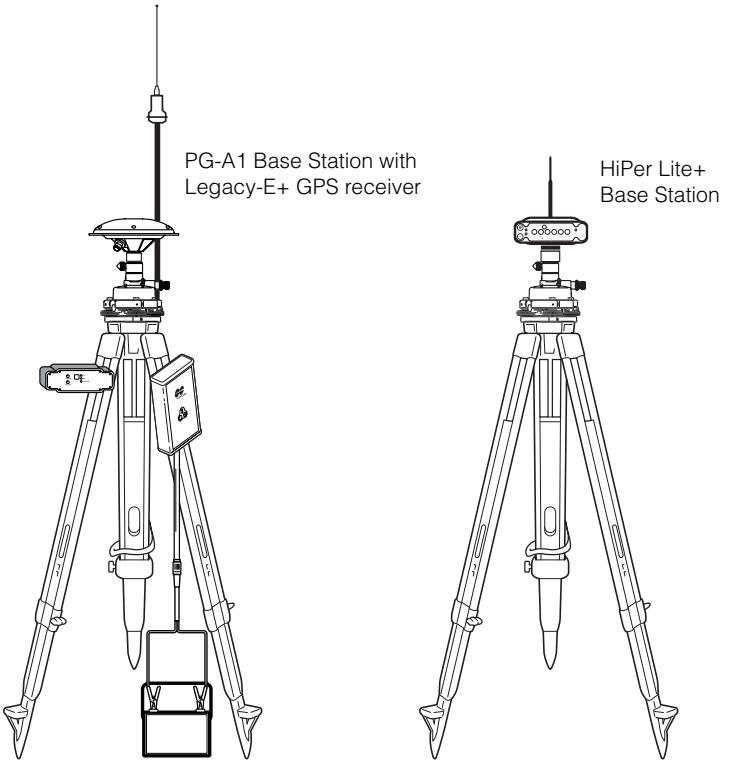


Figure 1-6. Base Station Kit Examples

Pocket-3D

Optional field software for all control applications, Pocket-3D assists superintendents, operators or grade checkers when staking or checking grade on a site. This software runs on a portable controller (Figure 1-7) and uses files common with other equipment on the job site, allowing multiple users to work at the same time.

Using Pocket-3D on an FC-100 (or other Pocket-PC based hand-held controller), you can:

- Set up and initialize the Base Station
- Create and edit Control Point files and Design Surface files
- Create and edit Machine Configuration files and radio configuration files
- Create and edit Point files and Linework files
- Import and export files
- Perform stakeout and grade check
- Perform topographic surveys

Figure 1-7. Pocket-3D on the FC-100

3Dxi Control Overview

To determine the position of the teeth, 3Dxi begins by reading the position of the MC-A1 antennas and using the data from the TS-1 on the body to locate the body of the machine in 3D space (Figure 1-8).

The remaining TS-1 sensors on the boom, stick, and bucket project the measured position out to the teeth.

NOTICE

Careful measurements of the machine lengths are important to overall accuracy.

With the added accuracy of RTK providing quick corrections from the Base Station, the cut/fill reading precisely provides, in real time, the difference between the teeth and the design elevation.

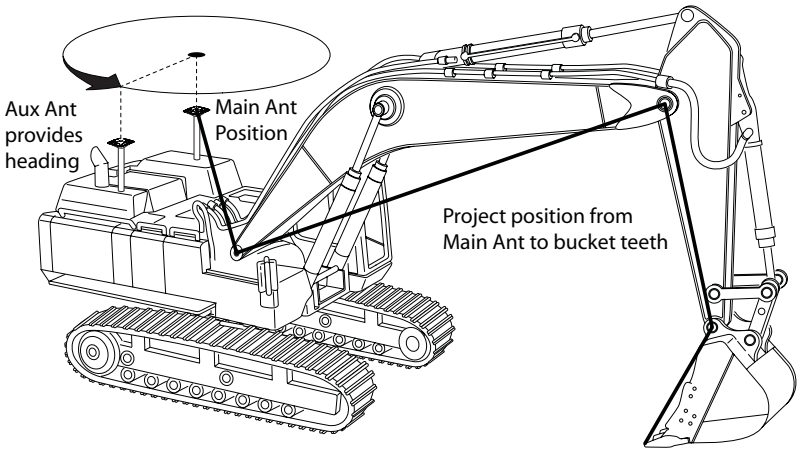


Figure 1-8. Determining Teeth Location

Component Functions

The components of the 3Dxi™ excavator system constantly communicate with each other to provide accurate, real-time measurements. Each component has a specific function to provide operator control, graphical jobsite displays, or GPS measurements for quick and easy grading.

GX-60 Control Box Features

The GX-60 control box is the operator's main interface with the 3Dxi excavator system, and provides the following functionality:

- displays the machine's position and orientation, as well as the distance between the teeth and finish grade
- translates user input into system commands
- communicates with system sensors, and processes information
- acts as a "personal computer" to support digital data

The operator controls 3Dxi operation using the LCD touch screen. A USB port on the front of the control box provides access to the internal memory for transferring files and other data; the top port on the back of the control box provide connections for the MC-2.5 receiver box and the TS-1 sensors (CAN communication).

The following sections describe the different features of the GX-60 control box in more detail.

LCD Touch Screen and Display

The LCD touch screen (Figure 2-1) provides textual information, graphic symbols and graphic mapping, all of which the operator can use to prepare a job, to apply changes on screens and functions, and to perform machine grading. For every operation, simply tap the screen with a finger to make selections or enter information.

Use the control box's buttons to vary the screen's backlight, so the operator can always view the screen's information under optimum brightness.

NOTICE

The surface of the Touch Screen Display has a durable coating, but avoid contact with metal or abrasive objects.

- Prevent hardware from contacting the display.
- Do not rub or force dust from the surface.

See "Touch Screen Display Cleaning" on page 6-2 for more information.

Also, avoid striking the display with heavy or sharp objects.

The touch screen display also provides an interface between the user and the 3DMC software application. For more information on the 3DMC software, see "3DMC Functions" on page 2-6.

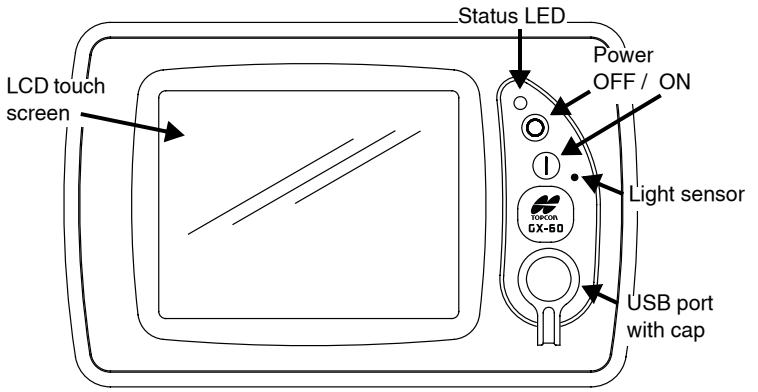


Figure 2-1. GX-60 Front

Status LED

The status LED (Figure 2-1 on page 2-2) indicates the power status of the GX-60 control box.

- Green – the control box is on.
- Red – the control box is powering on or off.

Power On/Off Buttons

The power buttons (Figure 2-1 on page 2-2) turn the control box on and off, as well as the connected components (MC-2.5 receiver box and sensors). A few moments after pressing the ON power button, the 3DMC main screen displays.

To turn on/off the GX-60, momentarily press the corresponding button.

Light Sensor

The internal light sensor (Figure 2-1 on page 2-2) measures ambient light, automatically adjusting the display's backlight to provide optimum viewing of the screen.

Blocking the light sensor may cause incorrect adjustments of the display's brightness level.

USB Port

The USB port (Figure 2-2) provides access to downloading files from or uploading files to a connected device (hand-held controller, keyboard, mouse) or USB device (data storage device). The internal driver is compatible with USB 1.0 or higher and commercially available USB devices and plugs. A rubber cap seals the port to prevent dust, water, etc. from entry.

Keep the USB port cap on when not in use to prevent dust from entering the port.

When copying files to/from a device connected to the port (data storage device, hand-held controller, etc.), an hourglass displays on the screen indicating that the system is busy.

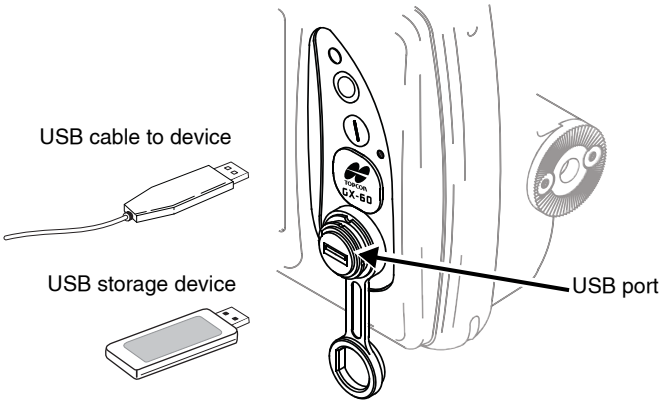


Figure 2-2. GX-60 USB Port

Connectors

The GX-60 has two serial-type connectors, but uses only one for the MC-2.5 box and the TS-1 sensors (Figure 2-3). A jaw mount or ball mount connects the control box to the machine's mounting bracket.

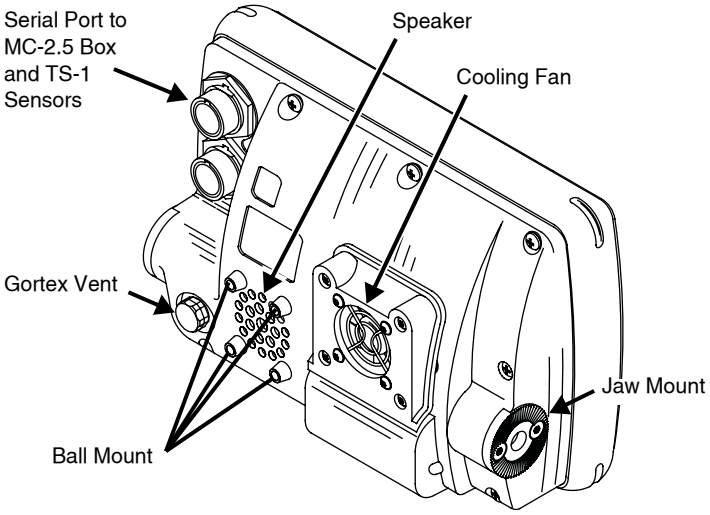


Figure 2-3. GX-60 Back

Speaker

The control box produces sounds through the speaker (Figure 2-3) to indicate certain activities, such as selecting a menu option or changing a selection on the touch screen.

Cooling Fan

An efficient air-cooling system keeps the control from overheating. When the control box is on, the cooling fan rotates to pull air into the interior of the control box (Figure 2-3). Air within the control box constantly circulates, cooling the internal components.

Do not obstruct the cooling fan.

3DMC Functions

The screen of the GX-60 control box provides an interface between the operator, the software, and the 3Dxi components. The screen displays jobsite information and the 3DMC menus needed to configure and use your 3Dxi components. The menus and keys allow files to be created, updated, superimposed, copied, or deleted. Information and files the operator can access will be stored and continuously updated to either the internal memory or a USB device.

When turning on the control box, 3DMC will start up. If the application has been exited, double-tap the icon on the screen to open 3DMC (Figure 2-4).

Figure 2-4. Open 3DMC

The 3DMC main screen (Figure 2-5 on page 2-7) displays a graphical view of the current Design Surface, the machine, and status information.

The main screen has the following components:

- Display – a graphical representation of the design surface and the machine. “Changing the Display Options” on page 5-17 describes the different displays available to view jobsite and grade information. Units can be in feet or metric.
- Pop-up Menus – tapping anywhere on the display screen brings up a pop-up menu. Depending on the view, the pop-up menu provides various functions, including design elevation at point tapped, steer/grade to polyline, move control, and grade indicator changes. For some pop-up menus, you may have to tap and hold for up to one second.
- Topcon Logo Key – accesses the menus that control 3Dxi functions. See “Topcon Logo Key” on page 2-9 for more information on the key and its menus.
- Zoom In Key – increases the magnification of the design view. The zooming pivot is the center of the screen.

- Zoom Out Key – decreases the magnification of the design. The zooming pivot is the center of the screen.
- Elevation Control Key – displays elevation control information and indicates the status of the connected sensor. Tap this key to view or edit elevation information. See “Elevation Control Key” on page 2-10 for more information on this key and its menu.

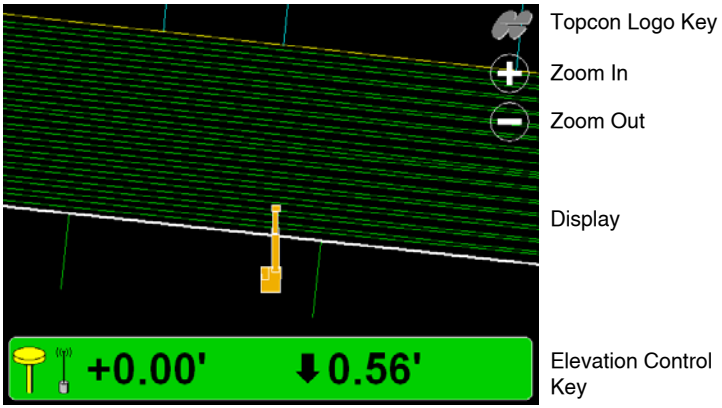


Figure 2-5. Main Screen

The various dialog boxes of the 3DMC application have buttons to perform operations, such as creating, updating, copying, or deleting files (Figure 2-6 on page 2-8). Any and all information the operator can access will be stored and continuously updated to either the internal memory or a USB device.

- New – Creates a new file or element.
- Edit – Changes an existing file or element. To edit a file, select a file or element, then press the **Edit** key.
- Copy – Copies a file either from the USB device to the internal memory or from the internal memory to the USB device. To copy a file, select a file, then press the **Copy** key. Copy new or edited files to the USB device to backup the file.
- Delete – Removes an existing file or element from the internal memory. To delete a file or element, select a file and press the **Delete** key.

NOTICE

Once you delete a file, it no longer exists. The file will need to be re-created.

- Next – Displays the next step or dialog box during an operation after all applicable settings have been entered.
- Back – Displays the previous step or dialog box during an operation.
- OK – Applies settings and inputs and exits the dialog box and/or operation, or used to change files or apply settings in sub-screens.
- Cancel – Cancels or pauses an operation without applying changes or edits. However, changes or edits on the previous screen will still be applied.

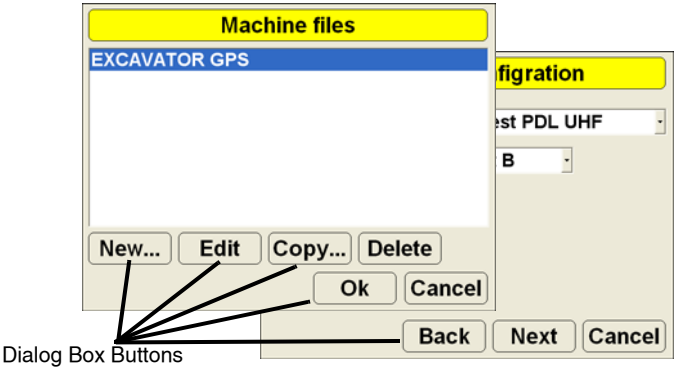


Figure 2-6. Example Dialog Box Buttons

When entering text or numbers, one of the following two pop-up keyboards displays (Figure 2-7 on page 2-9):

- Alphanumeric keyboard – for entering letters and numbers.
- Numeric keyboard – for entering numbers.

File and point names can be up to 32 characters long; point descriptions up to 64 characters long.

When you press **OK** on the keyboard, entered information is saved and the keyboard leaves the screen.

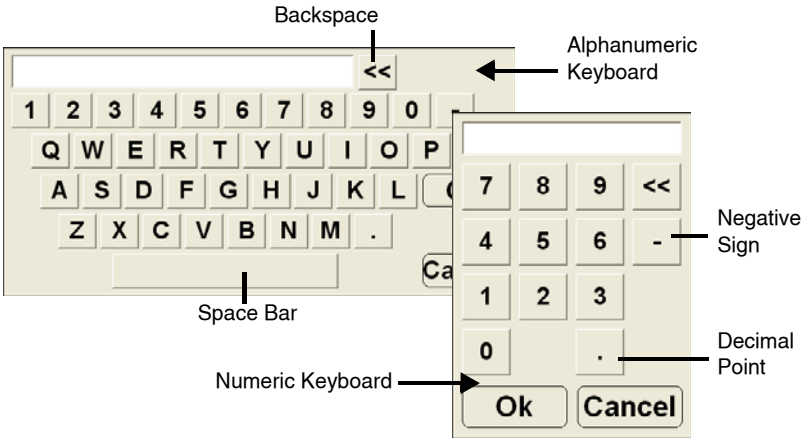


Figure 2-7. Keyboards

Topcon Logo Key

The Topcon Logo key at the top right corner of the Main Screen displays a pop-up bar of four menus: File, Control, Tools, and View.

To access the Topcon Logo menus (Figure 2-8), tap the **Topcon Logo**. Unless used, the menus disappear after 10 seconds.

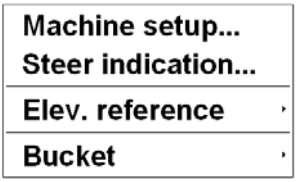
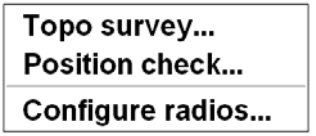
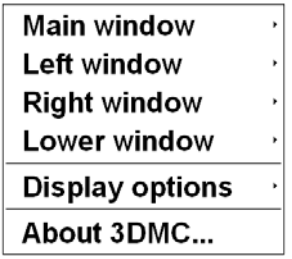
Figure 2-8. Topcon Logo Menus

Table 2-1 describes the functions available in each menu.

Table 2-1. 3DMC Menu Options for 3Dxi

Menu	Functions
File menu	• creates, edits, and deletes control point files • creates, edits, and selects design surface files • selects alignment files • selects linework • creates, edits, and deletes point files • exits 3DMC

Table 2-1. 3DMC Menu Options for 3Dxi (Continued)

Menu	Functions
Control menu 	• creates, edits, deletes, and applies configurations for the machine • sets the steering indication • selects the location of the elevation reference on the machine bucket • selects the configured and attached bucket
Tools menu 	• collects topographic points • checks the current position of the bucket • configures the radio
View menu 	• displays Plan, Section, and Profile views in the Main Window • displays a left window for Profile, Section, or the Grade indicator • displays a right window for the Grade indicator • displays a lower window for Profile, Section, or Light bar • views and selects display options for design surface, points, linework, background, and units; menu options depend on the file(s) selected for display • displays 3DMC information, authorization codes, and options

Elevation Control Key

The Elevation Control key displays cut/fill readings and the cut/fill offsets for the elevation of the blade. The key also indicates the status of the connected sensor with graphics, informational messages, and colors (Figure 2-9 on page 2-11).

- Receiver and Radio icons – displays the current status of the indicated component. The icon will be crossed out if the component is unavailable for some reason. Messages in the Elevation Control Key may indicate the reason.

- Left number – displays the current cut/fill offset, and can be changed at any time.
- Right number – displays the current cut/fill reading, or distance from finish grade. The number continuously updates according to the elevation difference between the cutting edge and the Design Surface. The arrow indicates if that distance is above (down arrow) or below (up arrow) the Design Surface.
- Elevation Control Key color – the background color of the elevation control key indicates sensor status. Green: sensor status suitable for grading; Red: an error status has occurred. Messages about system status also display.

When pressing the Elevation Control key, the ***Adjust elevation*** dialog box displays, containing elevation information and elevation configuration functions. See "3Dxi Operations" on page 5-1 for more details on using this dialog box.

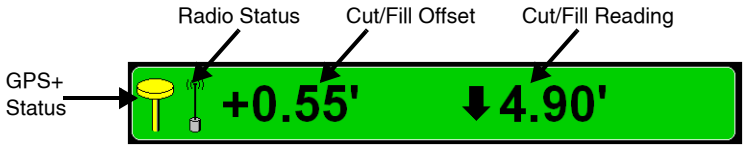


Figure 2-9. Elevation Control Key

Adjust Elevation

To display the ***Adjust elevation*** dialog box, press the **Elevation Control Key**. The ***Adjust elevation*** dialog box (Figure 2-10 on page 2-12) displays the following information and settings:

- Elevation (left edge) – displays the elevation of the left edge of the bucket based on local site coordinates.
- Elevation (right edge) – displays the elevation of the right edge of the bucket based on local site coordinates.
- Elevation set point – displays the current cut/fill offset, or amount of additional height applied to the Design Surface.
- Match – sets the current Design Surface to the elevation of the cutting edge, changing the cut/fill reading to zero. The cut/fill Offset number then displays the distance from the new, matched

grade to the original Design Surface. This key allows you to quickly adjust the grade to a more manageable cut or fill.

- Zero – sets the elevation set point value to zero.
- GPS info – displays the GPS information dialog box.

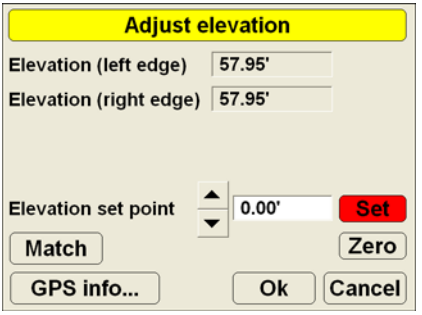


Figure 2-10. Open Adjust Elevation Dialog Box

See “Changing Cut/Fill Offsets” on page 5-12 for details on adjusting the elevation while grading.

GPS Info

To view the ***GPS information*** dialog box and tabs (Figure 2-11), press the **Elevation control** key, then press the **GPS info** button. For more information on the various tabs, see “Viewing GPS Information” on page 5-23.

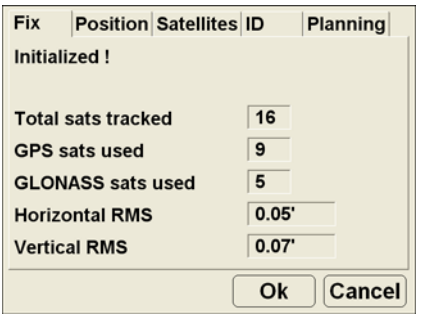


Figure 2-11. GPS Information Dialog Box

3DMC Options

The 3DMC software manages the options needed to enable the components for the desired application. For most applications, the authorization codes that enable options are initially entered at the factory. If purchasing upgrades to the system, the enabled options in the control box will need to be updated.

Viewing 3DMC Options

To view the enabled options for the GX-60 control box, press **Topcon Logo ▸ View ▸ About 3DMC**. The ***about 3DMC*** dialog box displays the version number, copyright date, publisher, and registered user (Figure 2-12) for the 3DMC software.

To view options enabled in the control box for 3Dxi, press **Options** (Figure 2-12). See the following section for details on modifying the options for system upgrades or updates.

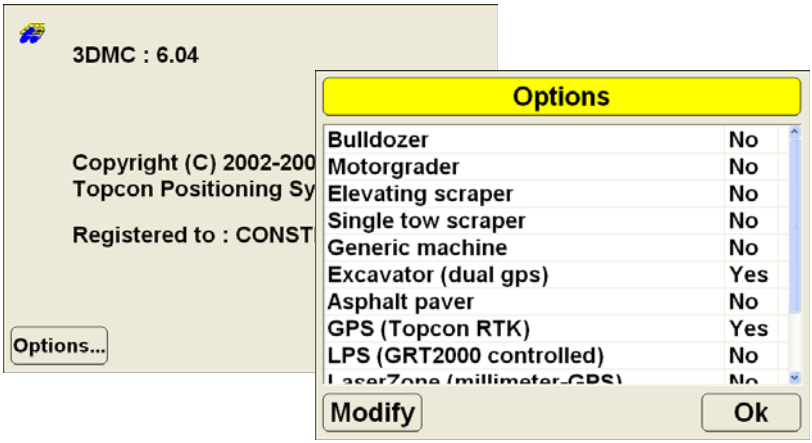


Figure 2-12. About 3DMC and GX-60 Options for 3Dxi

Updating 3DMC Options

3DMC options enable specific functions for different applications. Sometimes, you may want to purchase additional options; in this case, update the GX-60 with the new options.

1. To modify options, navigate to the ***Options*** dialog box and press **Modify** (Figure 2-12).
2. From the ***ControlBox*** dialog box, record the *Device identification* number to give to your Topcon representative. Contact your Topcon representative to obtain new authorization codes for the desired applications.
3. When you have received the new authorization codes, enter the codes in the ***ControlBox*** dialog box using the alpha-numeric keyboard (Figure 2-13).

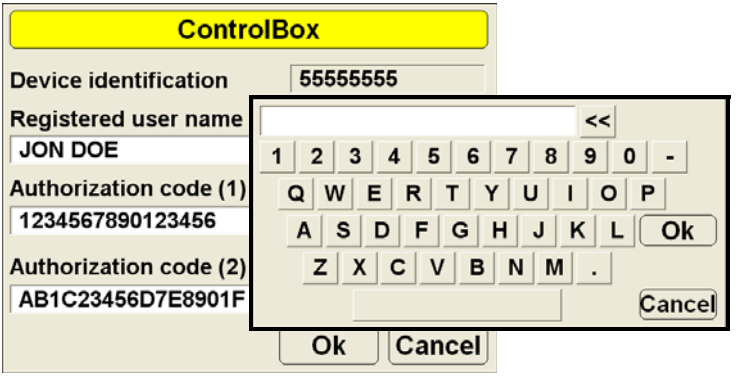


Figure 2-13. Enter New Authorization Codes

4. Press **Ok** to apply the new codes and options. Press **Ok** on each screen to return to the main screen.
5. Turn off, wait a couple seconds, and then turn on the control box to activate the new passwords.

MC-2.5 GPS Receiver Box Functions

Three LED indicators on the MC-2.5 GPS Receiver Box provide status on power, satellites, and radio signal (Figure 2-14 on page 2-16). Two function (FN) buttons provide diagnostic and reset for the internal receiver boards.

- Radio RX LED – radio status indicator. This LED blinks green when receiving data from the Base Station, typically once per second.
- Main LED and FN Button – power and satellite indicators for the Main antenna.
  - When the MC-2.5 box is hooked up to power, but is not connected to a GPS antenna and therefore not tracking any satellites, only the red LED blinks.
  - When the MC-2.5 box is attached to an MC-A1 GPS antenna, green blinks indicate the number GPS satellites being tracked; red blinks indicate the number of GLONASS satellites. A pause precedes each repetition of blinks.
  - Pressing the FN button changes the Main receiver board's information mode between Normal Mode and Extended Information Mode. See "Receiver Box Extended Information Mode" on page 2-16 for details.
- Aux LED and FN Button – power and satellite indicators for the Aux antenna.

  This LED and button perform the same functions as the Main LED and button, but for the Aux antenna.

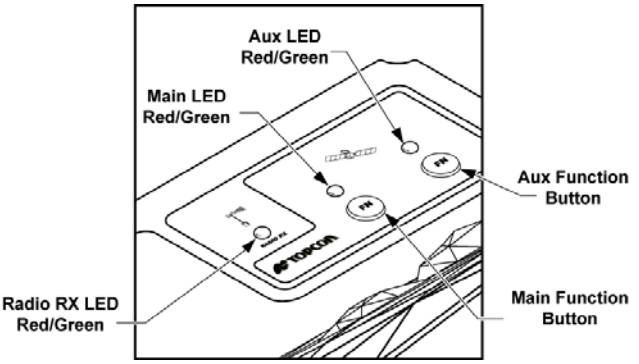


Figure 2-14. MC-2.5 GPS Receiver Box Indicators

Receiver Box Normal Mode

In normal mode, the LED indicates the number of tracked satellites and the position's computation status.

Receiver Box Extended Information Mode

EIM is used for receiver testing purposes. In this mode, the receiver continues to work as usual, but the LED indicates "extended" information using a delimiter. the delimiter is a distinguishable double-blink that shows the overall status of tests performed in EIM. The LED color for delimiter is calculated from the colors of other LED blinks.

- Orange – at least one blink is orange.
- Red – no orange blink and at least one red blink.
- Green – all other cases.

The delimiter double-blink is followed by six LED blinks corresponding to six receiver tests, where each blink indicates the following information:

Blink 1. Sufficient data for position computation.

Blink 2. GPS S/N ratios are good.

Blink 3. GLONASS S/N ratios are good.

Blink 4. Oscillator's frequency offset is less than three ppm.

Blink 5. Oscillator's Allan Variance is better than 2.7e-10.

Blink 6. Continuous tracking time is more than 15 minutes.

The color of the blink indicates that information for test is unavailable (orange), the receiver passed the test (green), or the receiver failed the test (red).

1. To switch to EIM, press and quickly release (within one second) the **Main FN** button.
2. Watch for the delimiter double-blink. With good receiver, antenna, and observation conditions, all blinks should be green within 15 minutes of powering on.
   - Green – ok
   - Orange – wait
   - Red – some tests failed
3. To switch back to normal mode, press the **Main FN** button.

Notes:

Applying Job Files

Before beginning to work with the 3Dxi™ excavator system, you must have job files that contain the various information needed to accurately grade the jobsite. The job files you need include control point files and design surface file. Using 3Dxi, you can also create a plane surface model to use for the design surface.

Creating a Control Point File

The first task, when setting up the 3Dxi on a new jobsite, is to create a new control point file. You can use either Pocket-3D or the GX-60 control box to create your Control Point files.

The control point file consists of descriptions, local site coordinates, global GPS coordinates, and units of measurements for each control point located on the site. Typically, the project's survey team provides control point information after accurately measuring these points with a surveying instrument.

The accuracy of the surveyor's measurements for local site coordinates of control points directly affects the quality of grade.

The control point file created here may be tentative, but will provide a beginning from which to create a more thorough file later. When performing localization, the control box processes the GPS information as the operator sits in the cab.

If a control point file is already available, use a USB device to copy it to the GX-60 (see "Copying Files" on page 5-26 for details).

1. Power on the GX-60. When 3DMC loads, press **Topcon Logo ▸ File ▸ Control**.
2. Press **New** to create a new control point file (Figure 3-1).
3. Tap the Name entry field to enter a name for the control point file (Figure 3-1). Press **OK** on the keyboard and then the New file dialog box.

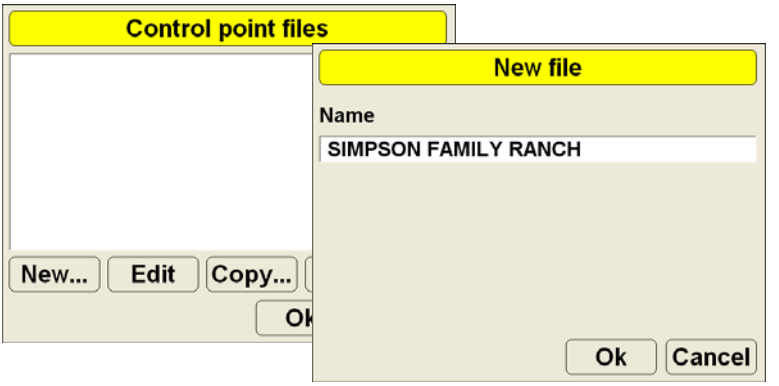


Figure 3-1. Create New Control Point File

4. Select the newly created control point file and press **Edit** (Figure 3-2).
5. Press **Add** to add a control point to the file.

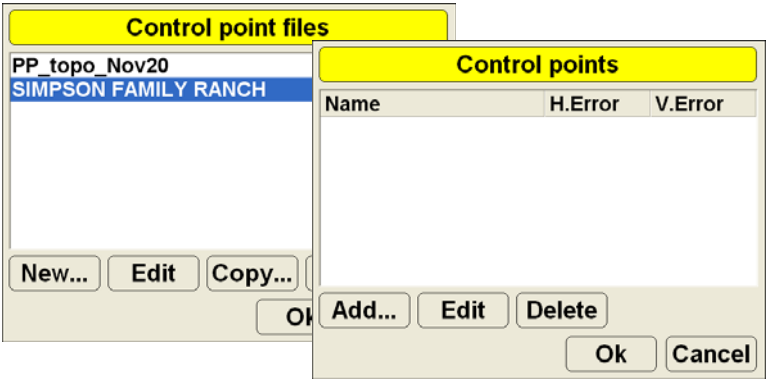


Figure 3-2. Edit Control Point File

6. Enter the following information (Figure 3-3) and press **Ok** to save the control point.
   - Name – tap and enter a name for the control point.
   - Site coords – tap each site coordinate entry box and enter the coordinates for point.
   - Check boxes – unless currently performing a GPS localization, disable (uncheck) the two GPS localization check boxes.
7. Repeat steps 6 and 7 for all available control points.

NOTICE Data entry errors directly affect grading accuracy.

8. Once you have added all control points, press **OK** to save the control point file (Figure 3-3).

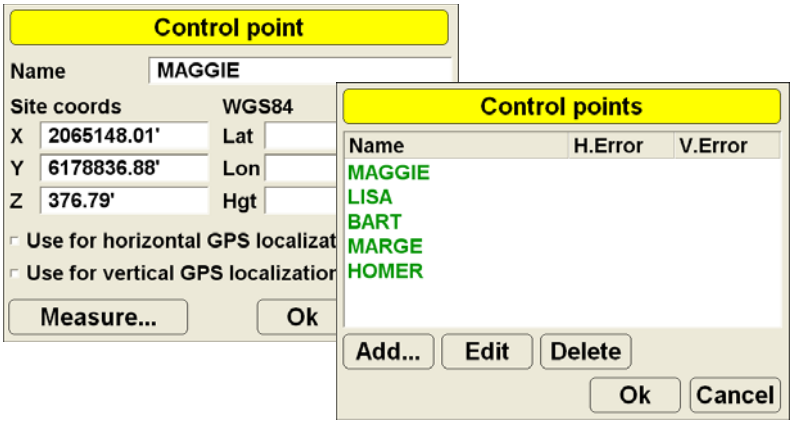


Figure 3-3. Enter Control Point Coordinates Without GPS Localization and Save Control Point File

Selecting a Design Surface File

For 3Dxi applications, the project engineer provides a Design Surface file for the jobsite. Before grading, the correct file must be copied from a USB storage device to the GX-60 and selected (see “Copying Files” on page 5-26 for details).

Once the GX-60 control box contains the correct Design Surface file, select it and apply it to the machine. Available Design Surface files depends on the jobsite and project.

1. Press **Topcon Logo ▸ File ▸ Surfaces ▸ Design**.
2. On the ***Surface files*** dialog box (Figure 3-4), select the design surface file for the job and press **Ok**.

   The main screen updates with the file’s information.

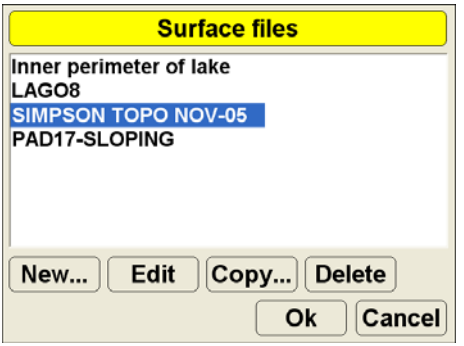


Figure 3-4. Select Design Surface Files

Creating a Plane Surface Model

The 3Dxi 3DMC software has the ability to create a plane surface model using a unique, on-site method. The plane surface model is created on the machine, in real-time, and can be used as a Design Surface file for grading. Unlike conventional applications using a laser, using 3Dxi to create a surface model eliminates the required, repetitive setup of a transmitter at the job site.

The plane surface model is composed of four basic factors: a mainfall orientation, a mainfall grade, a crossfall grade, and a reference elevation point on the plane. Just like aligning the rotating laser plane and adjusting the laser receiver height, the operator needs to be prepared with a set of relative information to fulfill the four factors. This information is composed of three points: A, B, and an elevation reference point.

Figure 3-5 on page 3-6 illustrates the basic factors needed for a plane surface model.

The following is the most common method using three reference points prepared at the site: two points (A and B) are measured to determine a mainfall orientation, and the other point (elevation reference point) is measured to determine an elevation.

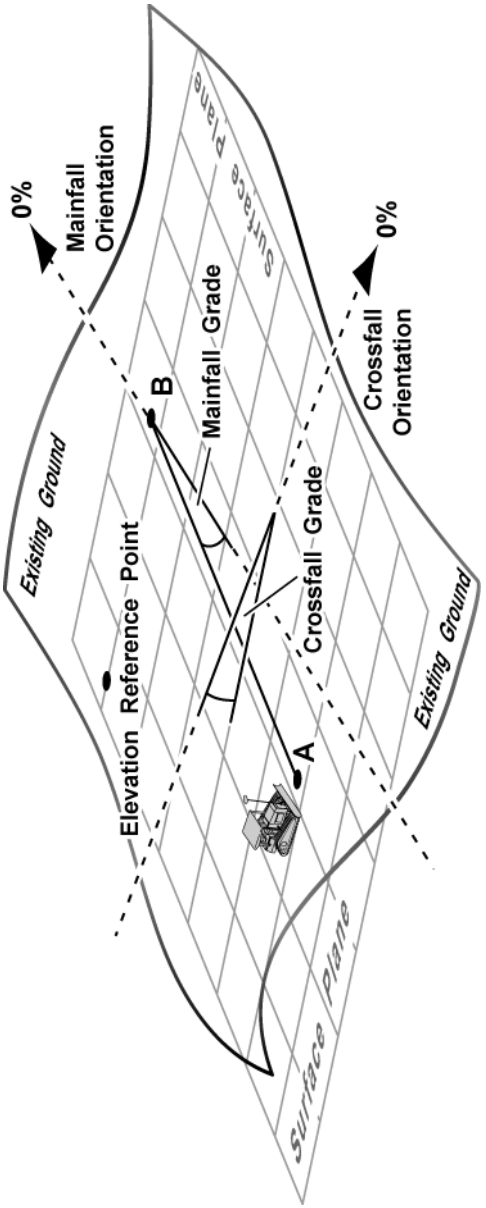


Figure 3-5. Plane Surface Diagram

1. Follow the directions in “Machine Setup” on page 4-9 to setup the 3Dxi components for the procedure that follows.
2. Press **Topcon Logo ▸ File ▸ Surfaces** and press **New** (Figure 3-6).

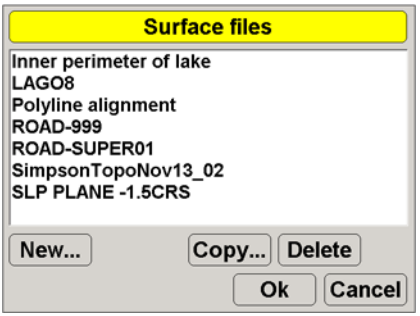


Figure 3-6. Design Surface Files

3. Enter and select the following information, then press **Next** (Figure 3-7):
   - Configuration name – tap and enter a name for the file.
   - Surface type – select either flat plane surface (no slope) or sloping plane surface (compound slope). If you select “flat plane surface”, skip to the step 8 on page 3-9.

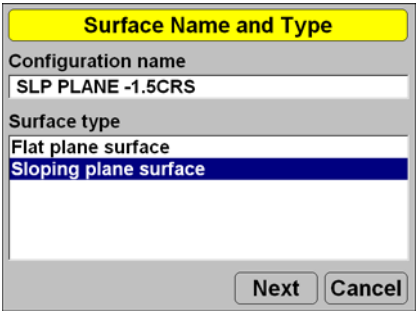


Figure 3-7. Surface Name and Type Dialog Box

4. Move the machine to point A and position the bucket over the selected point.

5. On the ***Sloping Plane Surface*** dialog box, and when the center of the bucket rests on the point/hub, press **A** to measure the point; the ***Measuring*** dialog box displays during the measurement process (Figure 3-8).
6. Move to B point and position the bucket over the selected point. On the ***Sloping Plane Surface*** dialog box, press **B** to measure the point; the ***Measuring*** dialog box displays during the measurement process (Figure 3-8).

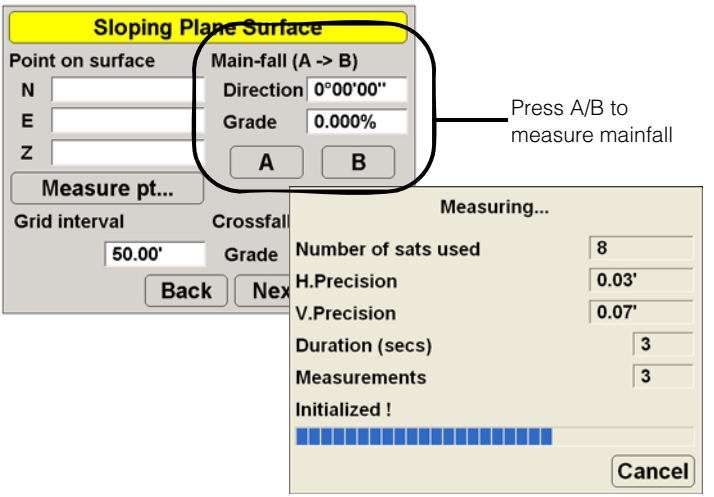


Figure 3-8. Measure Points A and B

Once the A and B point measurements finish, the control box determines the main fall orientation and grade connecting the A measurement toward the B measurement (see Figure 3-5 on page 3-6).

If needed, re-measure the points; the control box saves the A and B point coordinates separately. Also, it allows the operator to manually type in a desired grade by pressing the entry box.

A positive sign (+) designates an upgrade from A to B, and the negative (-) sign designates a downgrade from A to B (Figure 3-9 on page 3-9).

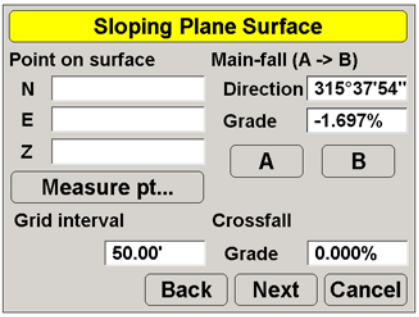


Figure 3-9. Points A and B Mainfall Grade Determined

7. Press the Crossfall Grade entry box, enter the desired cross fall grade and press **Ok** (Figure 3-10).

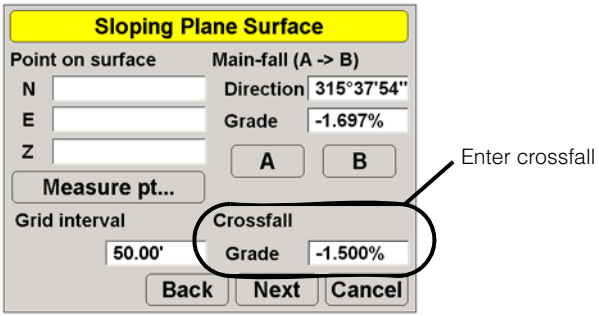


Figure 3-10. Enter Crossfall Grade

The cross fall grade is the grade that falls across at a 90° angle to the line of main fall (see Figure 3-5 on page 3-6), and together with the main fall, determines the plane with the compound slope. A positive (+) sign designates a fall from right to left, and a negative (-) sign designates a fall from left to right.

8. Move the machine to the elevation reference point. The measurement of this point brings the entire plane up or down to intersect with the plane and determine its relative elevation.

Use point A or point B for the elevation reference point.

9. On the ***Sloping Plane Surface*** dialog box, and when the center of the bucket rests on the elevation reference point/hub, press **Measure pt** to measure the elevation reference point (Figure 3-11). The measuring dialog box briefly displays.

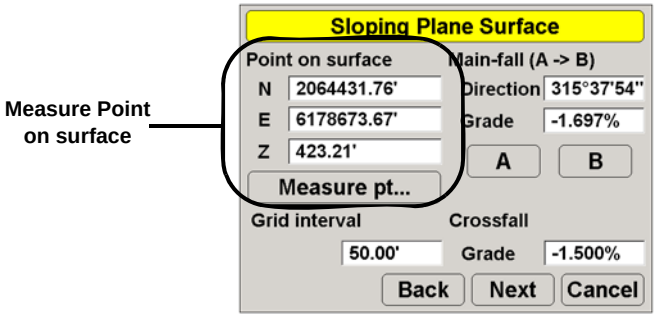


Figure 3-11. Measure Elevation Reference Point

If you have NEZ coordinates for the elevation reference point, press the applicable entry box and manually enter the information.

10. Press the Grid interval entry box, enter the desired grid interval to be represented on the Main Screen, and press **Ok** (Figure 3-12).

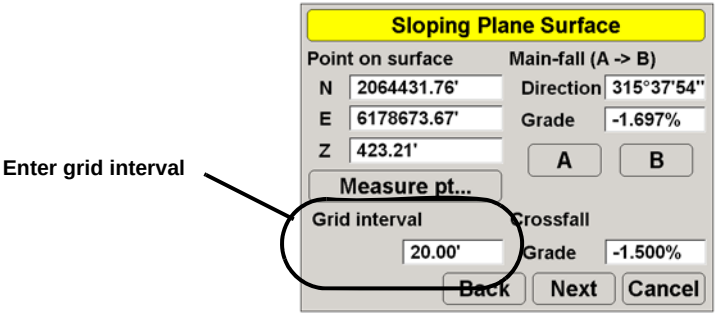


Figure 3-12. Enter Grid Interval

11. Press **Next** to review the created surface plane (Figure 3-13).
12. Press **Next** then **Finish** to save the created file and complete the plane surface (Figure 3-13).

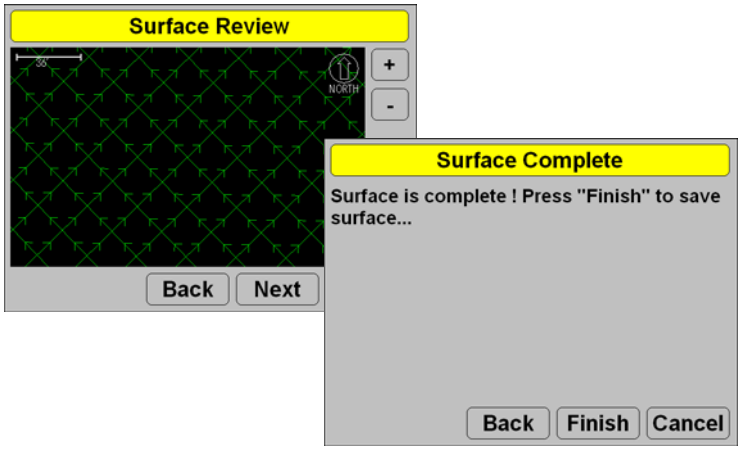


Figure 3-13. Review Surface and Save

NOTICE

Failure to press the Finish key will result in a loss of all the measurements and require the entire process to be repeated.

Notes:

Jobsite Setup

For indicate applications, first set up the machine components, then setup and initialize the Base Station, and finally, localize the GPS coordinates before grading. Several of the following sections assume an initial setup of components is being performed. If most of the components are attached and localization has been completed, simply connect any removable components, turn on the control box, and perform an accuracy test to ensure consistent grade.

Equipment Setup: Base Station

The Base Station always sets up over a Control Point on the jobsite; to ensure accuracy, the Base Station GPS+ antenna must be positioned directly over the top of the Control Point.

The Base Station can be set up and taken down on a daily basis, or can be mounted on a permanently fixed pole and left for the duration of the project. A permanent setup prevents errors due to incorrect antenna height measurements.

When setting up the Base Station, make sure you select the correct point from the Control Points file and verify the point has a northing, easting, and elevation coordinate. The more accurate these coordinates are, the tighter the control while grading.

- Install the Base Station over a control point – see page 4-2
- Measure the antenna height – see page 4-6
- Connect all Base Station components – see page 4-4
- Select the correct radio settings – see page 4-6 (refer to your Base Station's documentation for radio configuration procedures)
- Initialize the Base station – see page 4-6

Figure 4-2 on page 4-4 shows a completed Base Station setup.

Step 1: set up the tripod and GPS receiver/antenna over a control point, accurately level the tripod as described below.

Use a plumb bob for quick and easy setup of the tripod, especially if the ground is uneven.

1. Over a control point, extend the extension legs of the tripod to suitable lengths. Tighten the leg screws.
2. Attach the universal tribrach to the tripod, securing it in place (Figure 4-1) and insert the tribrach adapter into the tribrach.
3. Insert the horizontal spacer into the adapter and securely attach the GPS antenna to the spacer.

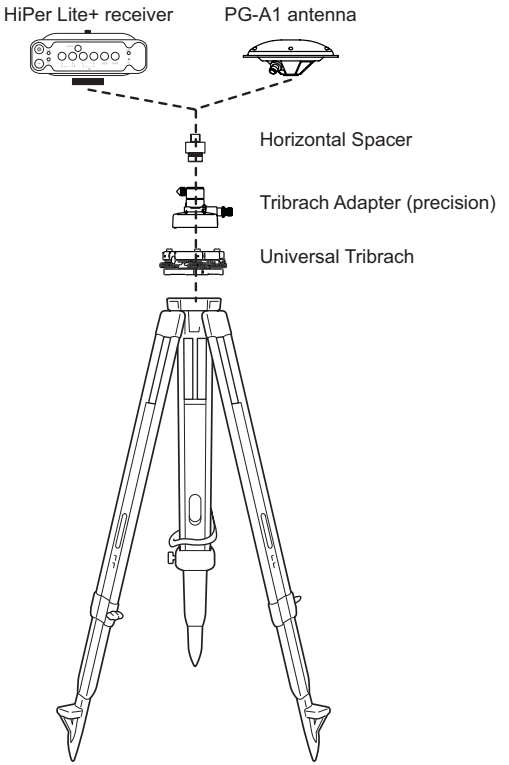
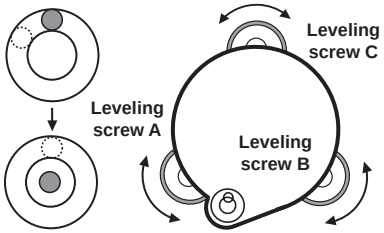


Figure 4-1. Base Station Setup

4. Roughly Level the Antenna Using the Circular Level.

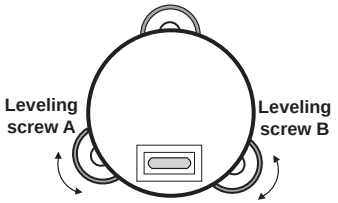
Turn leveling screws A and B to move the bubble in the circular level. The bubble is now located on a line perpendicular to a line running through the center of leveling screws A and B.



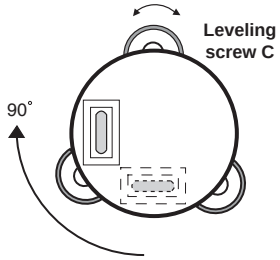
Turn leveling screw C to center the bubble in the circular level.

5. Center Using the Plate Level.

Rotate the instrument horizontally using the horizontal motion/clamp screw and place the plate level parallel with the line connecting leveling screws A and B. Turn leveling screws A and B to bring the bubble to the center of the plate level.



Rotate the instrument 90° around its vertical axis and turn leveling screw C to center the bubble once more.

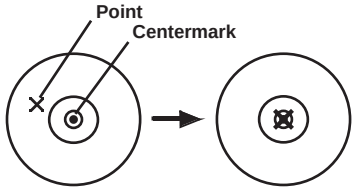


Repeat step 4 for each 90° rotation of the instrument and check that the bubble correctly centers at all four points.

6. Center Using the Optical Plummet Telescope.

Adjust the eyepiece of the optical plummet telescope to your eyesight.

Slide the instrument by loosening the tripod screw, place the point on the center mark, and then tighten the tripod screw. Slide the instrument carefully to prevent any dislocation of the bubble.



7. Level the Instrument.

Level the instrument as in step 4. Rotate the instrument, checking that the bubble is in the center of the plate level, regardless of telescope direction. Then tighten the tripod screw to lock in position.

Step 2: attach additional components to the tripod (Figure 4-2).

Attach and/or prepare additional Base Station components. These components will vary depending on the type of base station.

- For the PG-A1 base station, attach the radio modem, radio antenna, GPS receiver, and power source (optional).
- For the HiPer Lite+ base station, attach a power source (optional).

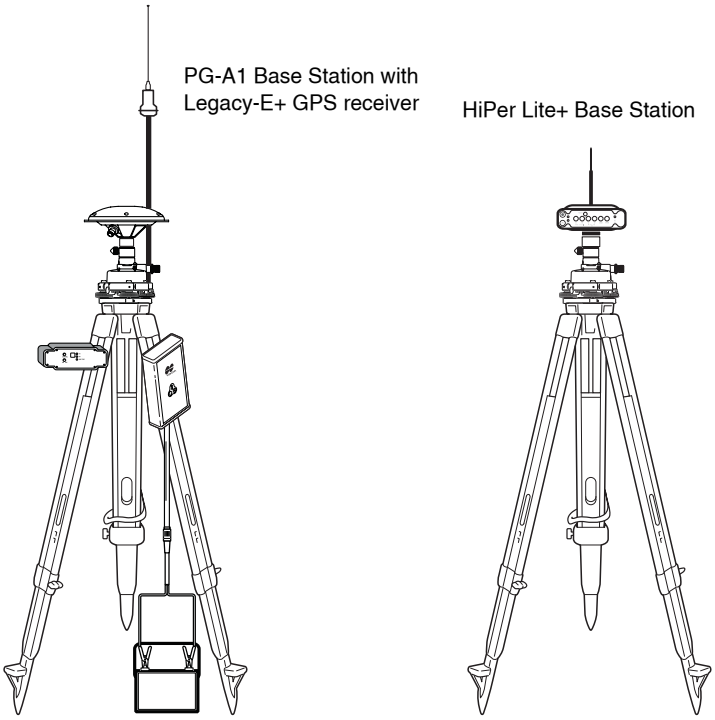


Figure 4-2. Base Station Setup

Step 3: connect component cables to the receiver (Legacy-E+ or HiPer Lite+), then connect the cables to other components (Figure 4-3 on page 4-5).

- If using Bluetooth wireless technology to connect a controller and the HiPer Lite+ receiver, refer to the controller's or receiver's documentation.

- Connect the following cables for the following components to the Legacy-E+ receiver, then to component:
  - GPS antenna: connect the antenna cable to the receiver's ANT port, then to the GPS antenna.
  - Power: connect the power cable to the receiver's PWR1 or PWR2 port. Attach the alligator clamps to the battery: RED to positive, BLACK to negative.
  - Radio Modem: connect the radio modem cable to the receiver's port C and the radio modem. Connect the other end to the battery.
  - Controller: connect the cable with 7-pin circular connector to the receiver's port A. Connect the other end of the cable to the controller. The controller will initialize the Base Station. See "Base Station Initialization" on page 4-6 for details.

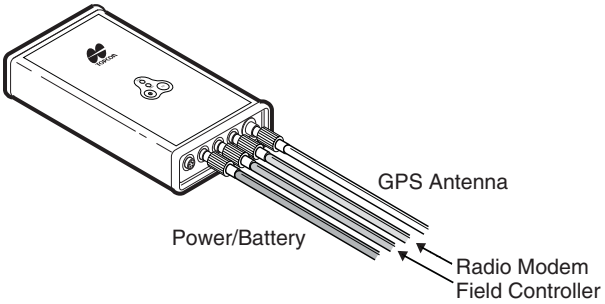


Figure 4-3. PG-A1 Base Station Cable Connections

Step 4: start the Base Station

1. Turn on the controller. For a PG-A1 base station, turn on the radio and select the correct channel on the radio modem.
2. Press the **PWR** button on the GPS receiver for one to two seconds. The power LED flashes red then rapidly green.

   Once powered up, the number of successive red and green flashes indicates the number satellites being tracked.
   - GPS – only green flashes
   - GPS+GLONASS – green flashes followed by red flashes

To turn off the receiver, press **PWR** button for one to two seconds until LEDs are off.

Step 5: measure the antenna height from the control point to the rim (slant) or ARP (vertical) of the antenna (Figure 4-4).

This measurement will be used when initializing the Base Station.

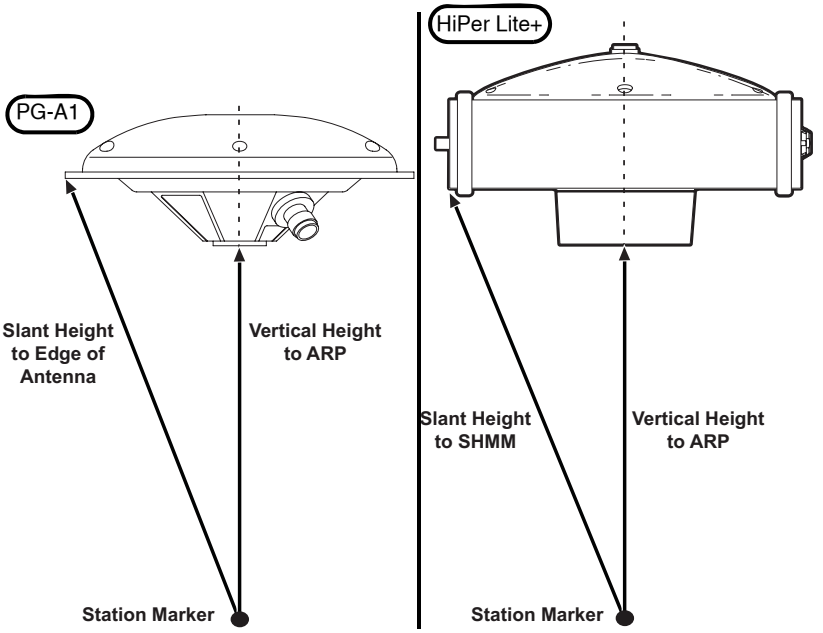


Figure 4-4. Measure Base Station Antenna Height

Base Station Initialization

Before initializing the Base Station, check the Units used in the current jobsite (Setup ▸ Units) and that the correct Control Point file is selected (Data ▸ Control). Figure 4-5 on page 4-7 shows the procedure listed below.

1. Connect the controller and receiver. Tap **Setup ▸ Base station**.
2. Select the control point over which the base station is installed and the connection between controller and receiver. Press **Next**.
3. Enter antenna type and height information. Press **Next**.
4. Enter radio type and communication information. If using a Pacific Crest PDL UHF radio, press **Configure** the select channel information and press **Set**. Press **Next**.

5. Select GPS receiver settings. Press **Finish** to initialize the GPS receiver and start the Base.
6. Immediately disconnect the Pocket-3D controller from the receiver.

Performing any other activities while connected to the Base Station will convert the Base to a Rover.

7. Check that the TX LED on the Base radio flashes once a second. This indicates data transmission.

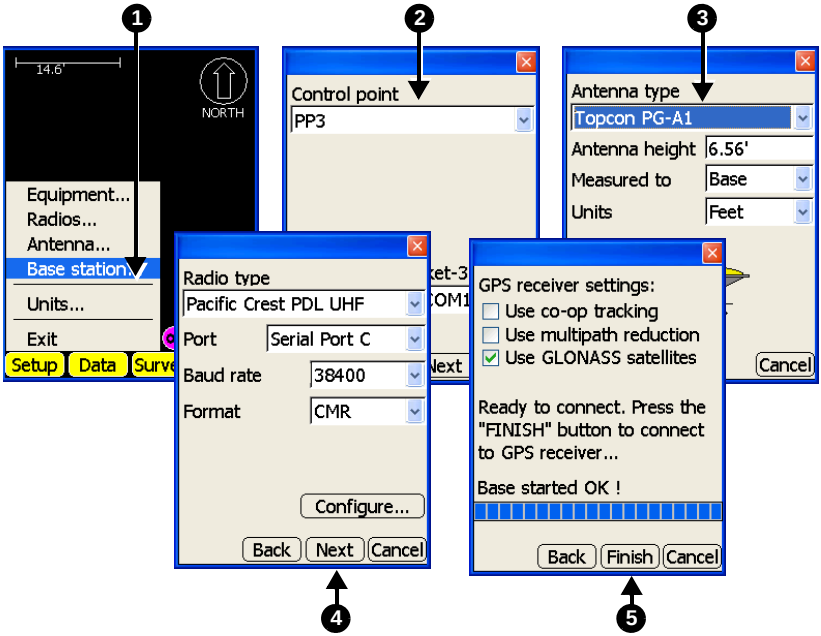


Figure 4-5. Enter Base Station Information and Start Base

General Base Station Setup Rules and Notes

- Every time the Base Station is setup, a new slant measurement must be taken since the height of the antenna will be different.

  Unless a fixed-height tripod, or something permanent, is used. Then you only need to measure the height of the antenna once. You will need to use Pocket-3D only for the initial processing since the GPS receiver will remember the initial settings. However, if any setting stored in the receiver has been changed or reset (like a reset function), you will need to re-initialize the Base Station.
- When the GPS receiver tracks a sufficient number of satellites, the receiver takes only a few seconds to process and report a successful start. See “Troubleshooting 3Dxi Components” on page 6-4 if the receiver fails to respond or fails to initialize.
- Ideally, the Base Station should be placed in an area free of object that can obstruct signals from satellites and degrade positioning accuracy. Obstructions can include trees, buildings, vehicles, or fences.
- Ideally, the radio antenna should not be placed too close to the GPS receiver. For large job sites, or sites with hilly terrain, use a tall tripod or a sturdy structure to raise the radio antenna as high as possible for better radio transmission range.

Machine Setup

Machine setup for 3Dxi excavator control application is quick and easy. First install the MC-A1 and Radio antennas, next install the MC-2.5 Receiver Box, the attach the GX-60 control box, and lastly connect the cables.

MC-A1 Antenna Setup

The MC-A1 GPS antenna is designed for quick setup at the beginning of the day and quick removal at the end of the day. Figure 4-6 illustrates the antenna setup for an excavator application.

1. Mount the MAIN antenna on the pole and connect the antenna cable to the antenna.
2. Tighten the hand knob firmly
3. Repeat steps 1 and 2 for the AUX antenna.

When facing forward, the MAIN antenna is on the left of the machine (Figure 4-6), or the side behind the cab.

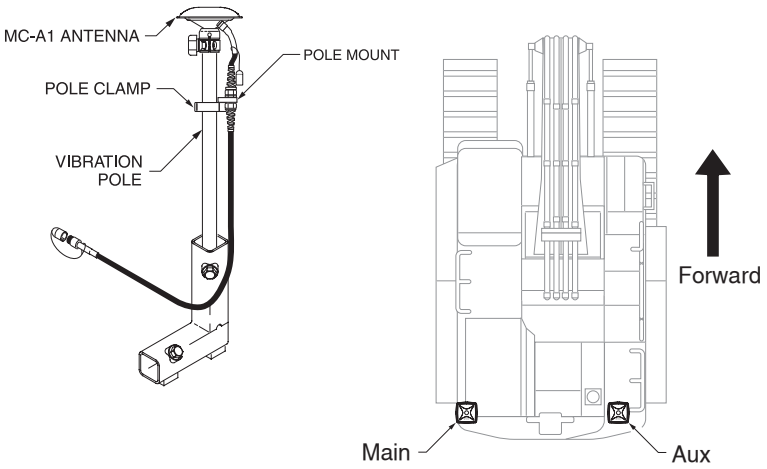


Figure 4-6. Excavator Antenna Attachment and Placement on Machine

Machine and Antenna Measurements

Take the following measurements for both antennas and the machine and record these measurements for entering into 3DMC (Figure 4-1):

- The distance from the center of the boom pivot line to the outside center of the Main antenna and to the AUX antenna.
- The distance from the boom center to the center of the Main antenna and to the AUX antenna.
- The height distance from the boom pivot line to the bottom of the ground plane of the Main antenna and the AUX antenna (from the rear, the Main antenna is on the left and the AUX antenna is on the right).
- The height distance from the ground to the boom pivot line.

Incorrect measurements or data entry errors have a direct affect on grading accuracy.

Take each measurement twice to ensure accuracy.

Table 4-1. Machine Measurements

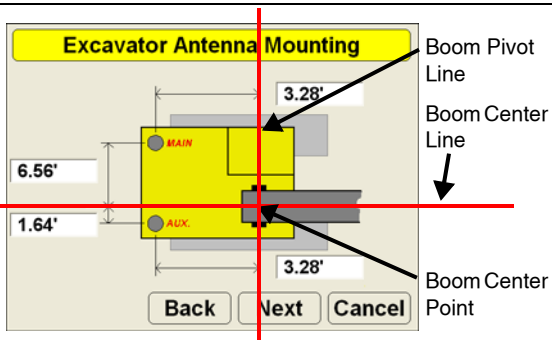
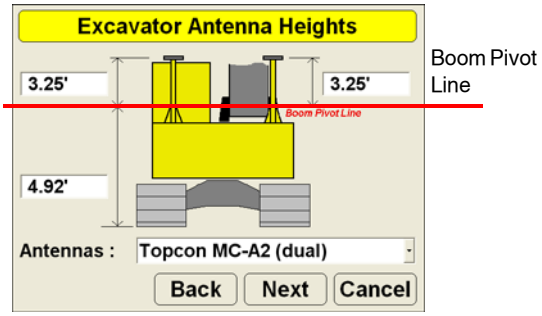
Measurements To Take	Screen Shot
Antenna Positions	

Table 4-1. Machine Measurements (Continued)

Measurements To Take	Screen Shot
Antenna Heights	

Machine Radio Antenna Setup

The machine radio antenna is attached to the machine's roof using a magnetic mount, and generally stays on the machine. The antenna should be positioned vertically and as high as possible on the machine to maximize signal reception (Figure 4-7).

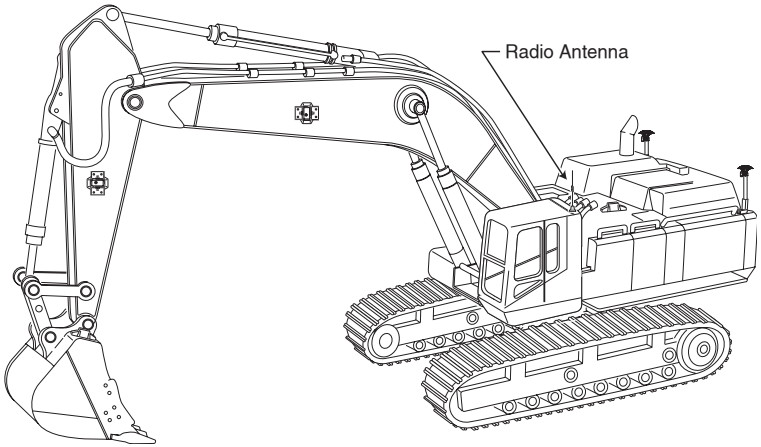


Figure 4-7. Rover Antenna Setup

MC-2.5 Receiver Box Setup

The MC-2.5 Receiver Box is designed for quick installation at the beginning of the day and quick removal at the end of the day.

1. Place the MC-2.5 Receiver Box in a suitable location (in the cab) where all four magnets attach to the machine. The LED lights should be visible to the operator, and all ports should be accessible to connect the cables.
2. Attach the following cables to the MC-2.5 Box (Figure 4-8):
   - The System Five-3D port to the control box.
   - The MC-A1 Antenna yellow cable to the Main GPS Antenna port, the black cable to the Aux GPS Antenna port.
   - The Rover Radio Antenna cable to Radio Antenna port.
   - Power cable to MAIN A.

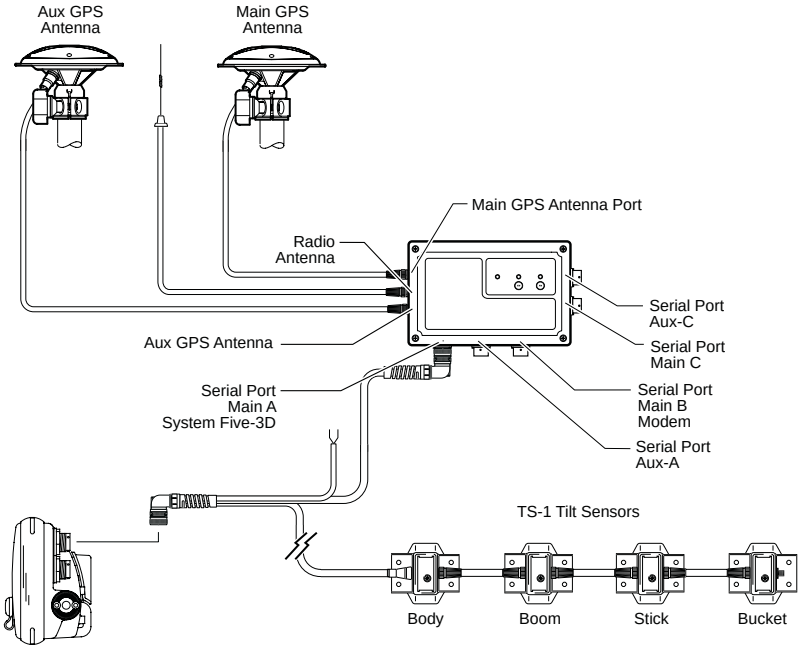


Figure 4-8. System Connections

Control Box Setup

The GX-60 control box is designed for quick attachment at the beginning of the day and quick removal at the end of the day.

1. Attach the control box to the in-cab mounting.
2. Connect the electrical cable to the top serial port (Figure 4-8).
3. Turn on the control box and allow the system to boot up.

Machine Configuration File for 3Dxi

The machine configuration file provides vital information about the type of machine, the setup of the components on the machine, machine measurements, and radio configuration information.

NOTICE

You must have a machine configuration file before beginning to grade.

Apply a 3Dxi Machine Configuration

1. Press **Topcon Logo** ▸ **Control** ▸ **Machine setup**.
2. Select the desired GPS-configured machine file and press **Ok** (Figure 4-9).

   3DMC will connect to the GPS components and the Elevation Control key will display a single antenna icon.

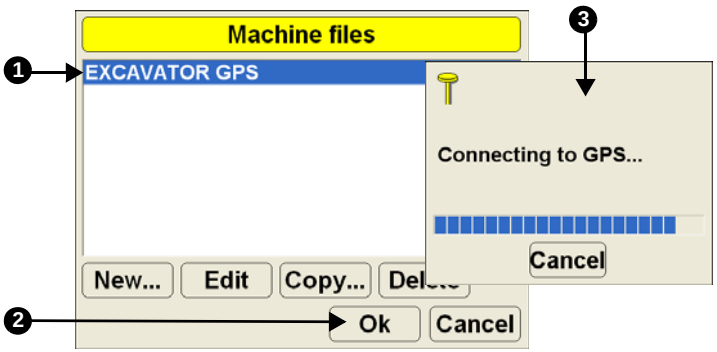


Figure 4-9. Selecting a GPS Machine Configuration

A simple check ensures that the machine receives corrections from the Base station: if the Elevation Control Key is green, the system is ready.

If the key is red or a status icon is crossed out, check the machine cable connections.
See “Troubleshooting 3Dxi Components” on page 6-4 for further information.

Create a 3Dxi Machine Configuration

For 3Dxi applications, select and enter antenna, bucket, and radio information.

Read the following procedure to determine the machine measurements required. Then have the measurements ready to enter when creating a machine configuration.

1. With the control box on, press **Topcon Logo** ▸ **Control** ▸ **Machine setup** to display the ***Machine files*** dialog box (Figure 4-10 on page 4-15).
2. Press **New** to begin creating a machine configuration file (Figure 4-10 on page 4-15). Enter the following information and press **Next**:
   - Configuration name – tap the entry box to display the alphanumeric keyboard. Type a name for the machine configuration and press **OK**.
   - Sensor – only “GPS antenna” available.
   - Location – only “Middle” available.
   - Units of measure – select the unit of measure (meters, feet, inches, centimeters).

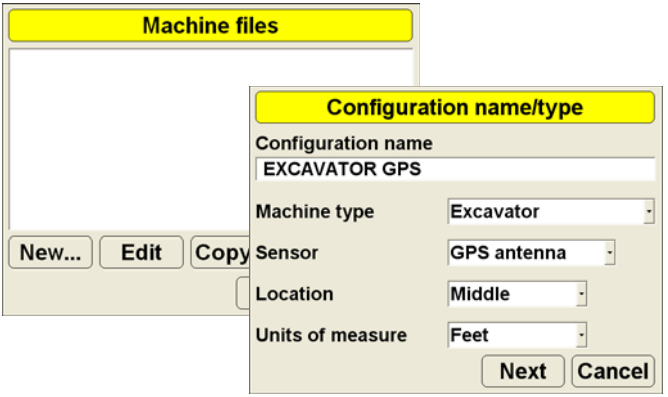


Figure 4-10. Create Machine Configuration File

3. For the next six to nine screens, depending on the type of machine and it's setup, see Appendix A. This chapter describes entering machine and antenna measurements, as well as calibrating the sensors. This information should already have been entered by the field manager or installer at this point.

NOTICE

Incorrect measurements or data entry errors have a direct affect on grading accuracy.

Take each measurement twice to ensure accuracy.

Table 4-2. Machine Measurements

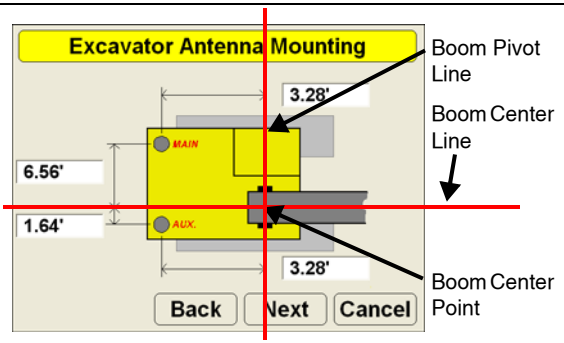
Measurements	Screen Shot
Antenna Positions	

Table 4-2. Machine Measurements (Continued)

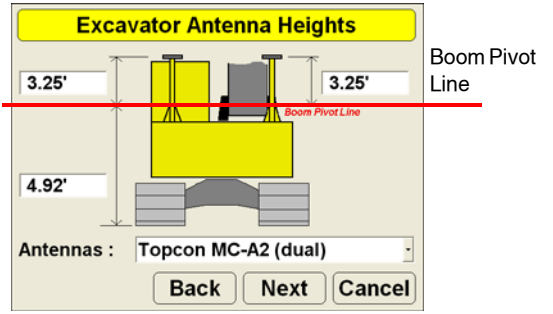
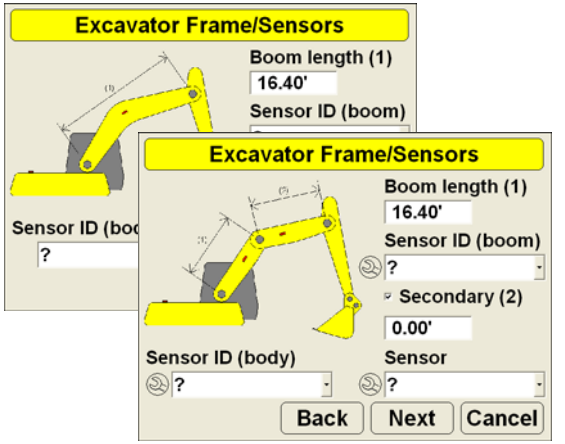
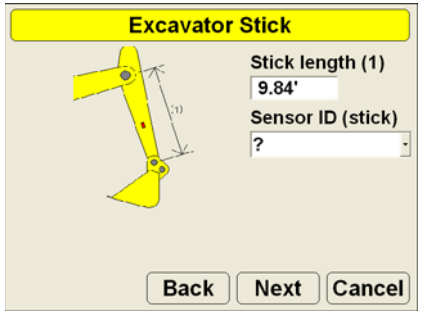
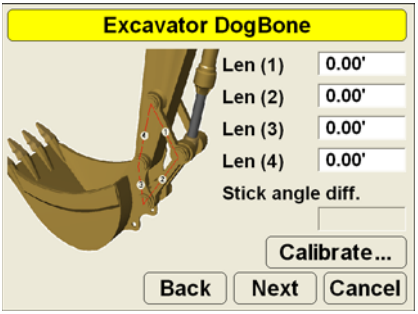
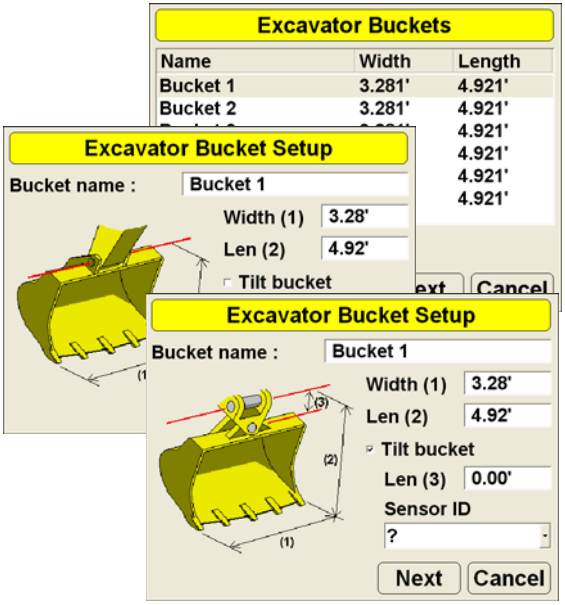
Measurements	Screen Shot
Antenna Heights	
Boom Length Optional secondary boom length	
Stick Length	

Table 4-2. Machine Measurements (Continued)

Measurements	Screen Shot
Optional Dog Bone	
Bucket Width and Length (repeated for each bucket) Optional tilt bucket measurement	

4. On the ***Excavator Buckets*** dialog box (after entering information for one to six buckets), press **Next**.
5. Enter the desired GPS precisions for roving and point measurements (Figure 4-11 on page 4-18).

6. On the ***GPS radio configuration*** dialog box (Figure 4-11), select the following information and tap **Next**:
   - Radio type – the radio type (examine the MC-2.5 box for a label indicating the type of internal radio)
   - Connected to – the serial port the radio is connected to, usually Serial Port B
   - Baud rate – 38400
   - Format – CMR

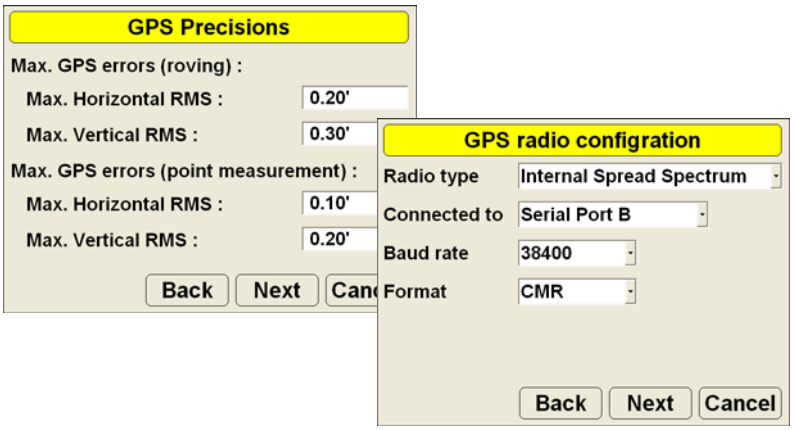


Figure 4-11. Enter GPS Precisions and Configure GPS Radio

7. Press **Finish** to complete and save the machine configuration file and return to the ***Machine setup*** dialog box.

NOTICE

You must press Finish to save the file. Failure to do so will result in losing all entered information.

8. Select the desired machine file, then press **Ok**.

NOTICE

An incorrect radio configuration setting will prevent the machine's radio from connecting with the Base Station. "No radio link" will display on the Elevation Control Key.

GPS Localization

After you have set up all the hardware components and initialized the Base Station, you need to localize the GPS coordinates to the jobsite's coordinates.

This section gives information on the principles of GPS localization and methods of GPS localization, as well as the procedures needed to localize using either Pocket-3D and an RTK Rover system, or the GX-60 control box and machine.

Principles of GPS Localization

The GPS system is capable of precise positioning, but the positions it computes are relative to a global reference system defined in terms of a geographic latitude, longitude and height above (a representation of) the earth's surface. To be useful for local site work, global GPS coordinates need to be converted into local site coordinates, defined in terms of a distance north and east of some origin point and some distance above an elevation datum. These north, east, and elevation coordinates (often abbreviated to NEZ coordinates) may be those of a regional coordinate system—e.g., a state plane system in the United States—or the project's survey crew may arbitrarily define these coordinates for the specific site. NEZ coordinates must be defined in terms of the construction design data. In either case, a mathematical conversion is necessary to turn global GPS coordinates into NEZ coordinates relative to the locally defined coordinate system.

The basic approach to calculating the mathematical conversion is to provide pairs of point coordinates for each control point on the project. A point pair consists of the following coordinates:

- local NEZ coordinates for the point (obtained from the project's survey crew)
- global latitude, longitude, and height coordinates for the point (measured as described in this section or obtained from the project's survey crew)

These point pairs are needed to calculate a precise mathematical conversion formula for converting all global GPS coordinates

generated in the GPS receiver to local NEZ coordinates for a particular project.

The following steps will help to ensure a high-quality localization suitable for centimeter-level machine grading with 3Dxi.

- First, the surveyor's local control points must be precisely measured. The quality of measurements directly affects grade accuracy.
- Second, the control points need to be located more or less evenly around the site. Generally, the more control points the better, but if they are clustered together or are all at one section of the site, the results will be less than ideal.

  A good rule of success is to locate control points evenly distributed around a perimeter of the site or grading area. While not directly related to quality of localization, locate control points that are elevated, easily accessible, and are not frequently obstructed by trees, buildings, other structures, moving vehicles, etc.
- GPS localization requires a minimum of three control points, but at least four or more points should be used for the localization.

Entering Localized GPS Coordinates

GPS localization is processed in the control point file created prior to beginning each project. This control point file contains the formula necessary for the mathematical conversion between global GPS coordinates and NEZ coordinates. The control point file can be localized by entering global GPS coordinates directly into the GX-60 control box. One of the following sources can measure points and provide coordinates:

- Each control point is measured with a Topcon GPS+ or GPS RTK Survey Rover System and Pocket-3D.
- A third party source provides GPS coordinates.

If the control point file in 3DMC needs to be updated with localized coordinates, the operator can enter global GPS coordinates directly into the GX-60 control box. The control box then processes the localization as the operator sits in the cab.

Because this method deals with control point files, see “Creating a Control Point File” on page 3-1 for further information.

1. Power on the control box and allow the 3DMC application program start up. Have the measurements for each Control Point available.
2. Press **Topcon Logo ▸ File ▸ Control Points**. The ***Control point files*** dialog box displays (Figure 4-12).
3. On the ***Control point files*** dialog box, select the correct control points file, and press **Edit**. The ***Control points*** dialog box displays, listing all control points for the file and jobsite (Figure 4-12).

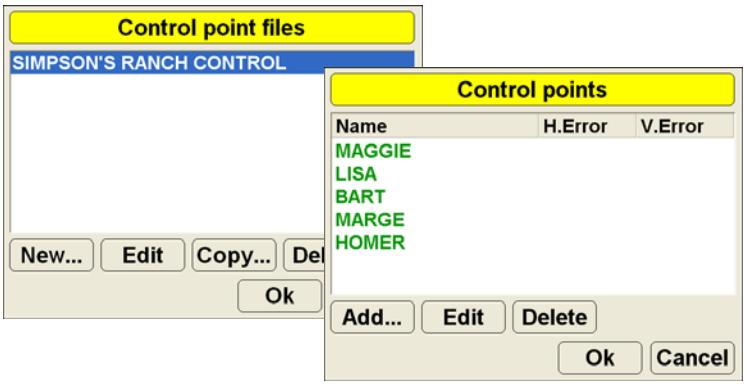


Figure 4-12. Control Point Files Dialog Box

4. Select a control point and press **Edit**, the ***Control point*** dialog box displays. This control point file should already have local site coordinates from the selected control point file (Figure 4-13 on page 4-22).
5. Tap in each WGS84 coordinate entry box to display the numeric pop-up keyboard and enter the coordinates for latitude (Lat), longitude (Lon) and height (Hgt) (Figure 4-13 on page 4-22).
6. Tap the two GPS localization check boxes to enable (check) them for performing the GPS localization mathematical conversion (Figure 4-13 on page 4-22).

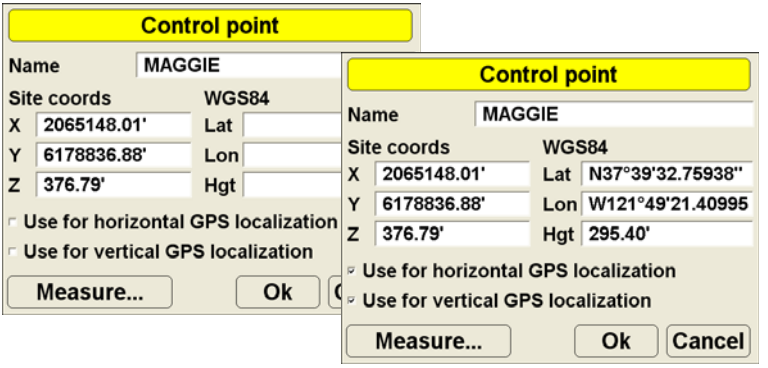


Figure 4-13. Control Point Coordinates and GPS Localization

7. Press **Ok** to return to the ***Control point files*** dialog box.
8. Repeat step 4 to step 7 for all listed control points. When finished, check the horizontal (H.Error) and vertical (V.Error) values listed on the ***Control points*** dialog box. They should be within acceptable tolerances (Figure 4-14).

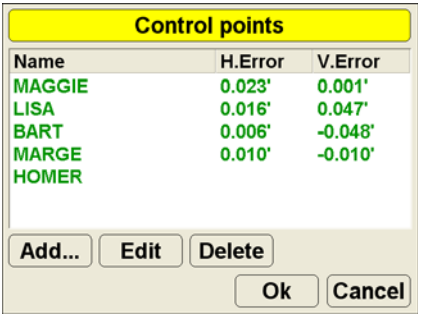


Figure 4-14. Control Point Files with GPS Localization

9. Press **Ok** until you return to the 3DMC main screen, saving the control point localization information and the control points file.

At this time, make a backup copy of the control point file on a USB device.

3Dxi Operations

Once you have your 3Dxi™ excavator system set up, most grading operations remain the same. This chapter discusses operations typically performed while grading:

- changing the views
- changing cut/fill offsets
- changing the grade indicator scale
- checking position
- changing buckets
- changing the display options
- viewing GPS information
- copying files
- changing radio channels

Other application and operation functions described include the following:

- Steering and grading to a polyline
- Performing a topographic survey
- Clearing the NVRAM of the MC-2.5 Box

Before Grading Checklist

Before beginning to grade at the job site, review the setup procedures and ensure all steps have been completed.

- ☐ Base station is set up and functioning (page 4-1):
  - ☐ All cables securely attached (page 4-4)
  - ☐ Base station has power (page 4-5)
  - ☐ Base station initialized (page 4-6)
- ☐ Machine components attached and functioning:
  - ☐ Machine MC-A1 antennas (page 4-9) and Radio antenna (page 4-11) attached and cables connected
  - ☐ MC-2.5 Box attached and cables connected (page 4-12)
  - ☐ GX-60 control box attached and cables connected, and the control box powered on (page 4-13)
- ☐ Correct job files are active:
  - ☐ Control Point file (page 3-1)
  - ☐ Design Surface file (page 3-4)
  - ☐ Machine Configuration file (page 4-13)
- ☐ Check the color of the Elevation key to ensure all sensors are communicating and functioning:
  - GREEN – all sensors function properly
  - RED – a part of the system is working improperly; text or graphical information indicates the problem
- ☐ Perform a position check to ensure consistent grade (page 5-15).

Once all components are attached, connected to the GX-60 control box and functioning, you can begin grading.

Changing the View

The GX-60 control box can display several types of views, each of which contains useful information. Some options require specific files, provided from the design engineer or other sources on the project.

Main Window Views

Display options for the main window include a Plan view, a Section view, and a Profile view.

To access the desired main window view, press **Topcon Logo** ▸ **View** ▸ **Main window** (Figure 5-1), then tap the desired view; a check mark indicates the active view.

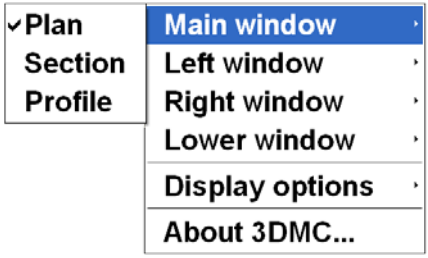


Figure 5-1. Main Window Display Menu Selections

The Plan view (Figure 5-2 on page 5-4) displays the jobsite from above the machine, and the main window is always oriented in the forward direction of machine travel.

This view allows for additional representations of triangle mesh and contour lines in a desired color; as well as superimposing Linework, Alignment lines, and Topo points.

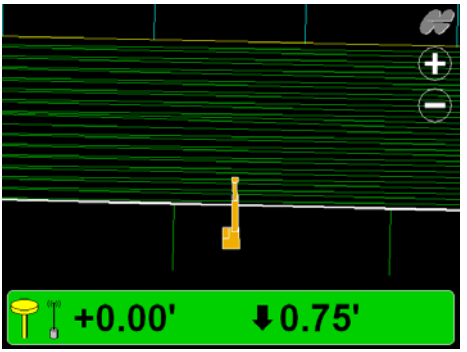


Figure 5-2. Plan View on Main Window

The Section view (Figure 5-3) displays a cross section of the cutting edge and the selected Design Surface where the right side of the Main Screen is the right side cutting edge.

- The cut/fill readings are provided on both sides of the blade and represent how far the cutting edge is from on-grade.
- When a road surface model is selected, the centerline and the elements on the template are represented in red.
- Additionally, the section view displays steering information from a target alignment line to a target edge and the longitudinal distance along the road.

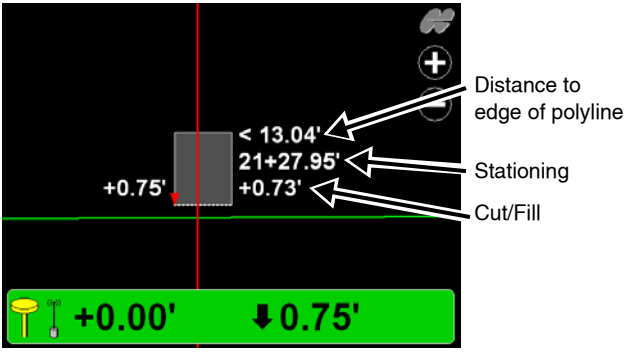


Figure 5-3. Section View on Main Window

The Profile view (Figure 5-4) displays a side view of the machine where the right side of the screen is always the forward direction of machine travel.

Use the focus body/bucket feature to center the machine on the screen as desired (see “Focus Body and Focus Bucket Views” on page 5-9).

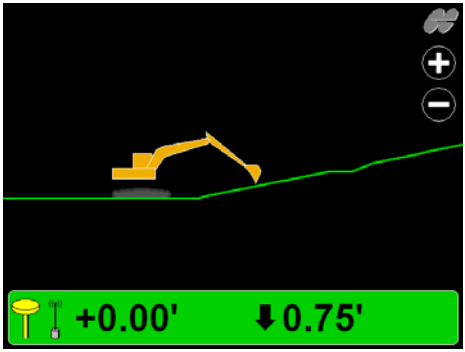


Figure 5-4. Profile View on Main Window

Left Window Views

Display options for the left window include a Profile view, a Section view, and a Grade indicator.

To access the desired left window view, have the Plan view visible and press **Topcon Logo ▸ View ▸ Left window** (Figure 5-5), then tap the desired view; a check mark indicates the active view. “None” indicates no left window is active.

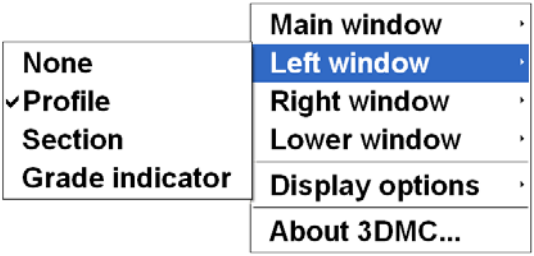


Figure 5-5. Left Window Display Menu Selections

Selecting one of the options adds the indicated view as a small window at the upper left of the display (Figure 5-6 on page 5-6).

The Profile view displays a side view of the machine where the right side of the view is always the forward direction of machine travel. The "+/-" buttons increase and decrease magnification for this view.

The Section view displays a cross section view of the cutting edge and the selected Design Surface where the right side of the view is the right side cutting edge. Cut/fill readings are provided on both sides of the blade and represent how far the cutting edge is from on-grade. The "+/-" buttons increase/decrease magnification for this view.

The Grade indicator view acts as an infinitely scrolling grade tape, displaying the amount of cut or fill in regards to the design surface. For details on the Grade indicator pop-up menu, see "Changing the Grade Indicator Scale" on page 5-13.

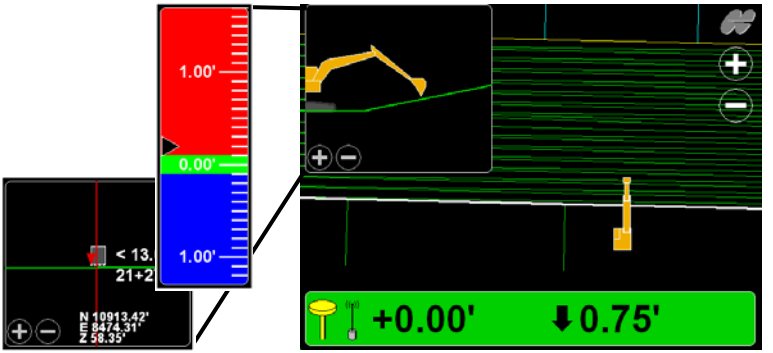


Figure 5-6. Left Window Views

The selected Left window view will remain visible when showing Right/Lower window views.

Right Window View

Only the grade indicator is available as a view in the right window.

To access the right window view, have the Plan view visible and press **Topcon Logo ▸ View ▸ Right window** (Figure 5-9 on page 5-8), then tap the desired view; a check mark indicates the active view. None indicates no right window is active.

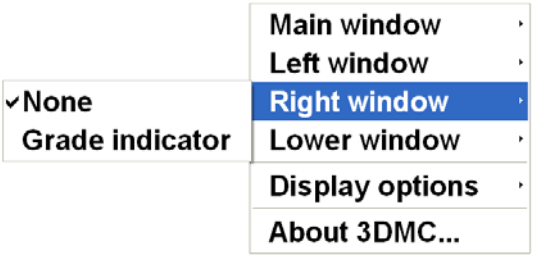


Figure 5-7. Right Window Display Menu Selections

Selecting one of the options adds the indicated view as a small window above the Elevation Control key (Figure 5-8).

The Grade indicator view acts as an infinitely scrolling grade tape, displaying the amount of cut or fill in regards to the design surface. For details on the Grade indicator pop-up menu, see “Changing the Grade Indicator Scale” on page 5-13.

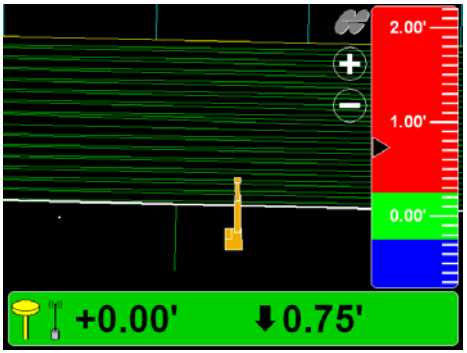


Figure 5-8. Right Window View

The selected Right window view will remain visible when showing Left/Lower window views.

Lower Window Views

Display options for the lower window include a Profile view, a Section view, and a Light bar.

To access the desired lower window view, have the Plan view visible and press **Topcon Logo ▸ View ▸ Lower window**, then tap the desired view; a check mark indicates the active view. None indicates no lower window is active.

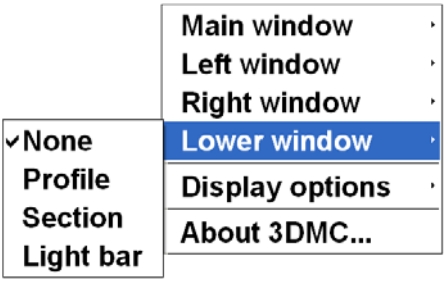


Figure 5-9. Lower Window Display Menu Selections

Selecting one of the options adds the indicated view as a small window above the Elevation Control key (Figure 5-10 on page 5-9).

The Profile view displays a side view of the machine where the right side of the screen is always the forward direction of machine travel. The "+/-" buttons increase/decrease magnification for this view.

The Section view displays a cross section view of the cutting edge and the selected Design Surface where the right side of the view is the right side of the cutting edge. Cut/fill readings are provided on both sides of the blade and represent how far the cutting edge is from on-grade. The "+/-" buttons increase/decrease magnification for this view.

The Light bar is used for steering indication where the green zone indicates "on-grade". The zone can be increased or decreased using the Steer Indication screen. The Light Bar option is only available when the job includes alignment information.

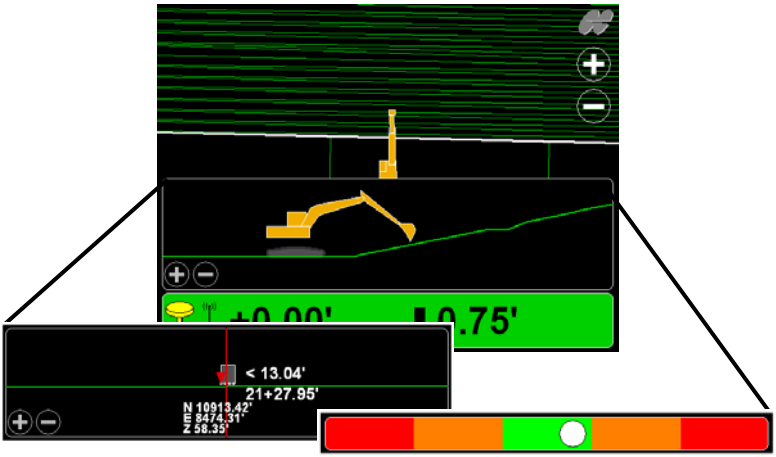


Figure 5-10. Lower Window Views

The selected Lower window view will remain visible when showing Left/Right window views.

Focus Body and Focus Bucket Views

The Plan and Profile Views can focus on either the body or the bucket. To change the focus, press the main screen for one to two seconds until the pop-up menu displays (Figure 5-11). A check mark indicates the currently active focus function.

- Use the Focus Body option to center the body of the machine in the view. Enter a number to add a forward offset to the view of the machine (zero will focus on the center of the body).
- Use the Focus Bucket option to center the bucket in the view.

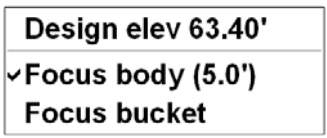


Figure 5-11. Popup Menu (Plan View)

The focus body and focus bucket options are available in the plan view and all profile views (Figure 5-12).

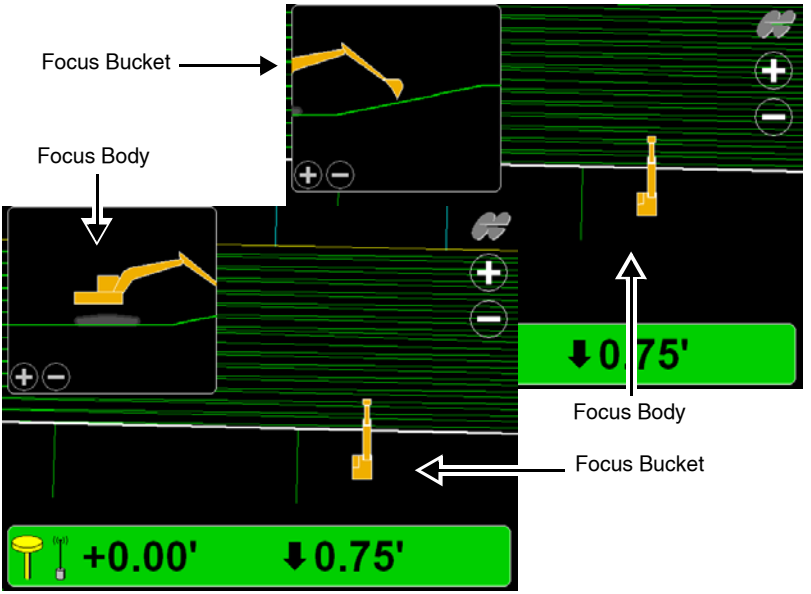


Figure 5-12. Focus Body and Bucket Examples for Plan and Profile Views

Setting the Elevation Reference

The elevation reference function selects the point along the bucket teeth that the elevation will be calculated from.

Using the Section view to change the elevation reference

To move to the far left or far right edge of the blade, press and hold the edge of the blade for one second. On the pop-up menu, tap **Move control left** or **Move control right**. The blade control arrow moves accordingly (Figure 5-13).

Figure 5-13. Move Elevation Reference Using Section View

Using the Control menu to change the elevation reference

1. Press **Topcon Logo ▸ Control ▸ Elev. reference**.
2. Select either *Left edge*, *Middle*, or *Right edge* of bucket.

The elevation reference arrow—seen on the teeth edge of the bucket in a section view—will move accordingly (Figure 5-14).

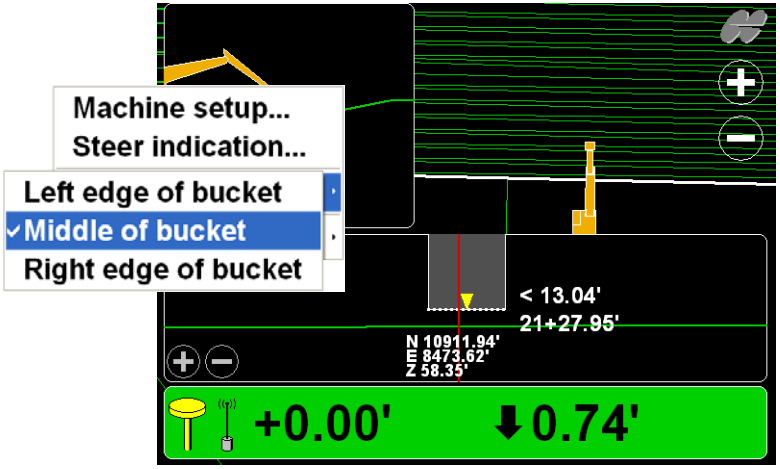


Figure 5-14. Elevation Reference on Bucket

Changing Cut/Fill Offsets

The cut/fill offset can be manually adjusted relative to the Design Surface. After each pass, the cut/fill offset can be updated as necessary while approaching the final design surface.

When changing the cut/fill offset, both the Elevation Control key and Grade Indicator reflect the new value.

1. On the 3DMC Main Screen, press the **Elevation Control** key to display the ***Adjust elevation*** dialog box (Figure 5-15).
2. Press the *Elevation set point* **Set** key, changing it to red.

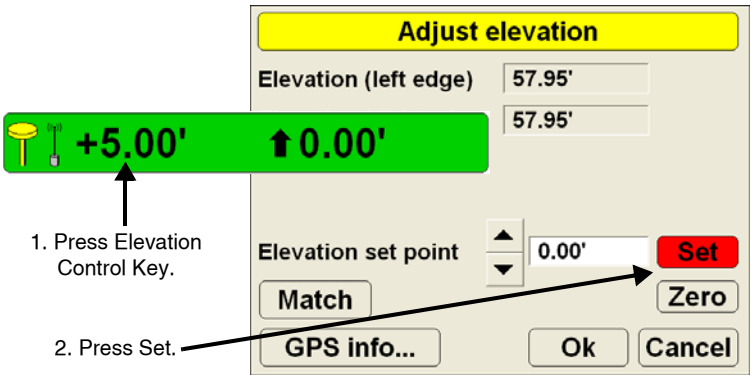


Figure 5-15. Press Elevation Control Key then Set

3. Tap the *Elevation set point* entry box, and enter a new offset using the numerical keyboard. Press **Ok**.

   A negative value is a Cut; a positive value is a Fill.
4. Press **Ok** to set the new offset value and return to the 3DMC Main Screen.

Changing the Grade Indicator Scale

The Grade Indicator acts as an infinitely scrolling grade tape, and displays the amount of cut or fill in regards to the design surface.

To view the grade indicator, press **Topcon Logo ▸ View ▸ Left window ▸ Grade indicator**. This process applies to both the left and right Grade Indicators.

To change the grade display, press and hold the **grade indicator for one second**, tap **Grade display**, then the desired option. This option applies a cut/fill reference for a position on the cutting edge.

- At left edge – the grade tape follows the position left edge of the bucket.
- In from edge – the grade tape follows a position on the bucket an entered distance from the left edge. Tap to display the numeric pop-up keyboard to enter a distance from the left edge.

Example: Left Edge

When using the Left Edge, the grade tape will follow the cut/fill status of the left side of the bucket, regardless if elevation reference point is at the middle or right edge of the bucket. The cut/fill number in the elevation control key is tied directly to the Elevation Reference point.

The Elevation Control Key reflects the elevation reference point.

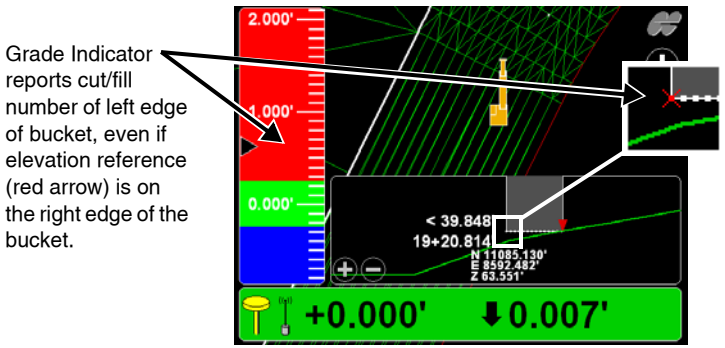


Figure 5-16. Example: Grade Indicator and Left Edge Cut/fill

Example: In From Edge

When using In From Edge, the grade tape will follow the cut/fill of the entered distance from the left side of the bucket, regardless if elevation reference point is at the middle or right edge of the bucket. The cut/fill number in the elevation control key is tied directly to the Elevation Reference point.

The Elevation Control Key reflects the elevation reference point.

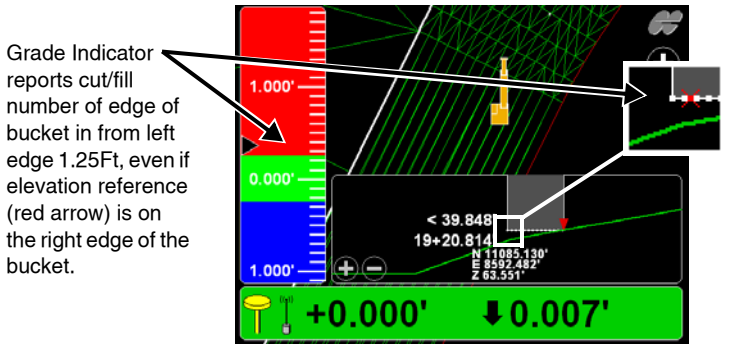


Figure 5-17. Example: Grade Indicator and In From Left Edge Cut/fill

To change the on-grade or extents, press and hold the **grade indicator for one second**, then tap the desired menu option (Figure 5-18).

- On-grade – displays the current on-grade (green zone) width. Tap to change the on-grade zone.
- Extents – displays the current scale (unit spacing) for the grade indicator. Tap to change the unit spacing.

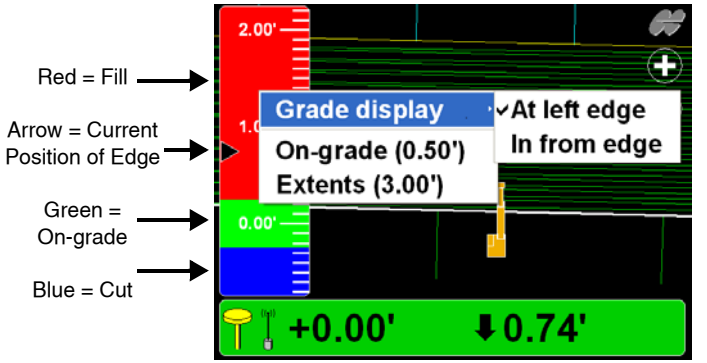


Figure 5-18. Grade Indicator Pop-up Menu

Checking the Position of the Bucket Teeth

The position check option provides a daily benchmarking tool to verify that the calculated elevation and position are repeatable.

1. To check the position of the blade, press **Topcon Logo** ▸ **Tools** ▸ **Position check**.
2. On the ***Position Check*** dialog box, select the *Point of interest* (left edge or right edge of bucket), and press **Measure** (Figure 5-19); the ***Measuring*** dialog box displays during measurement.
3. When finished, the ***Position check*** dialog box displays the point on the job for the selected edge of the blade (Figure 5-19).
4. Record the position and verify the accuracy of the measurement with a survey Rover.
5. Press **Cancel** to return to the Main Screen.

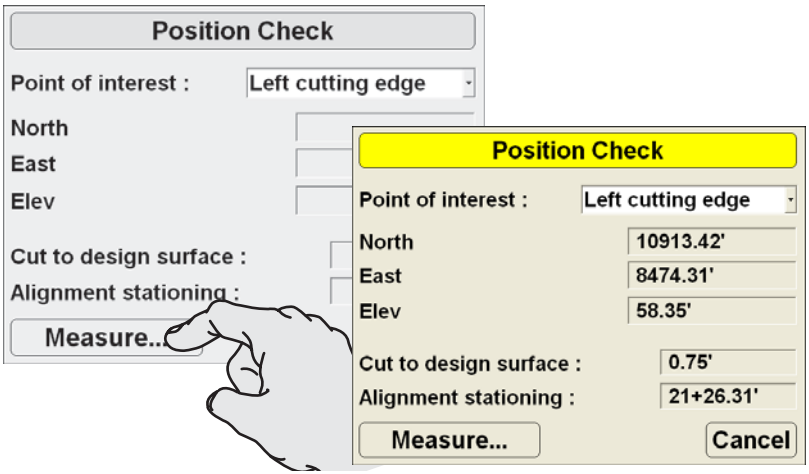


Figure 5-19. Select Point of Interest and Press Measure

Changing Buckets

The 3DMC application software can be configured with up to six bucket setups.

- If mounted to a quick change coupler or the dog-bone, the TS-1 will remain on the coupler when the bucket changes.
- Without mounting on a quick change coupler or dog-bone, the TS-1 will have to be re-calibrated (see Appendix A for details).

When changing buckets, the new bucket must be set up in 3DMC and will be listed in the Control ▸ Bucket menu. For the bucket setup procedure, see “Machine Configuration File for 3Dxi” on page 4-13. Bucket setups can be updated at any time.

Click **Topcon Logo ▸ Control ▸ Bucket** and select the new bucket from the list (Figure 5-20). A check mark indicates the currently selected bucket. (Note that in this example, the default names are used for the buckets.)

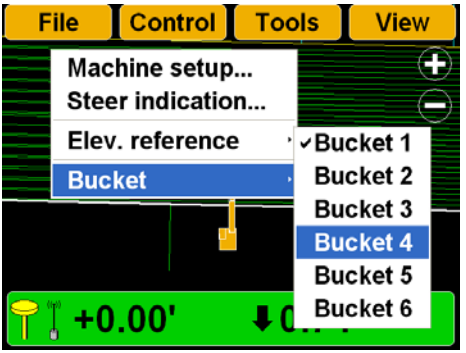


Figure 5-20. Select New Bucket

Changing the Display Options

The GX-60 control box also contains settings for the various displays available that can be changed to fit the job. Some options require specific files, provided from the design engineer or other sources on the project.

Design Surface Display Options

When using a TIN surface model file, press **Topcon Logo** ▸ **View** ▸ **Display options** ▸ **Design Surface** to display the ***Design surface*** dialog box (Figure 5-21).

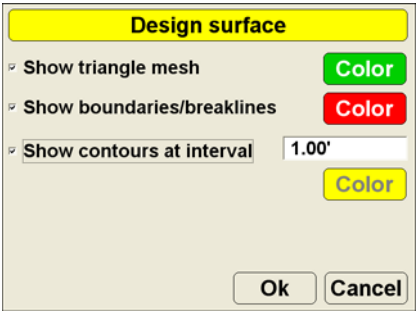
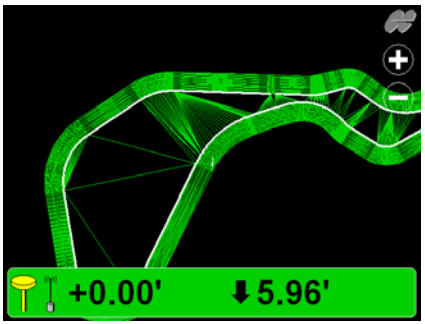
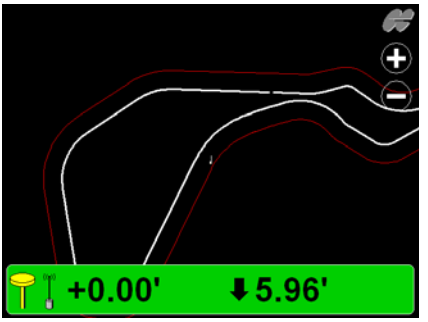
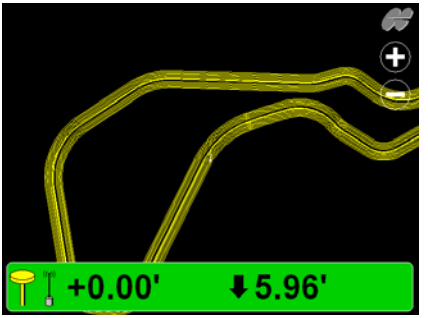
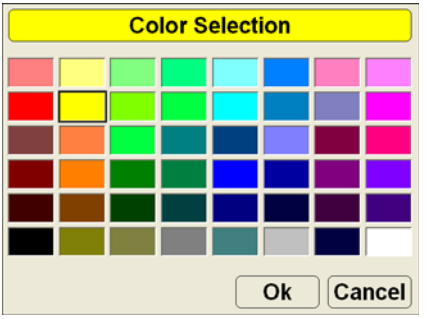


Figure 5-21. Design Surface Display Options

This dialog box has the following selections:

• Show triangle mesh – displays triangle lines on the Main Screen according to the TIN Surface Model.	

• Show boundaries/ breaklines – displays boundary lines and breaklines outlining the Design Surface.	
• Show contours at intervals – displays contour lines on the Main Screen; tap the entry box to display the numeric pop-up keyboard and specify the elevation spacing interval between lines.	
• Color – press to display the ***Color Selection*** dialog box. You can change the color of the triangle mesh, boundary/ breaklines, and contours to the operator's preference, or to maintain consistency between the office and the field.	

Alignment Display Options

When using either a road surface model or an alignment file, press **Topcon Logo ▸ View ▸ Display options ▸ Alignment** to display the ***Alignment*** dialog box (Figure 5-22).

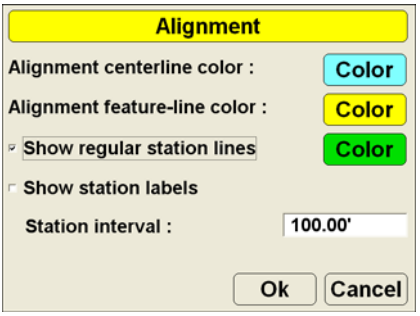


Figure 5-22. Alignment Display Options

This dialog box has the following selections:

- Alignment centerline color – sets the color of the centerline.
- Alignment feature-line color – sets the color for feature lines.
- Show regular station lines – displays graphical cross lines relative to the horizontal alignments on the Main Screen (Figure 5-23). Press the **Station interval entry box** to specify the longitudinal interval between lines.

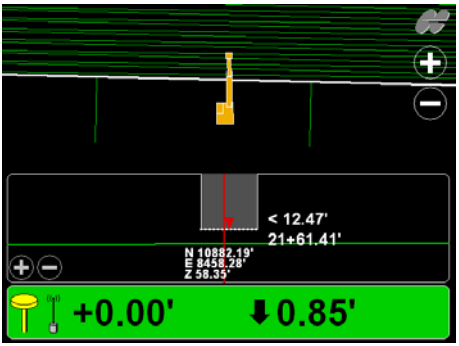


Figure 5-23. Station Lines in Main Screen

- Show station labels – displays station labels for each station on the Main Screen.

Linework Display Options

When using a Linework file, press **Topcon Logo ▸ View ▸ Display options ▸ Linework** to display the ***Linework layers*** dialog box (Figure 5-24).

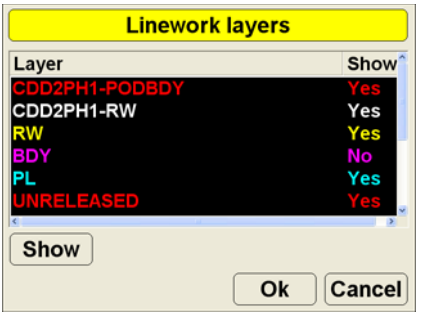


Figure 5-24. Linework Layers

The Linework file contains layers composed of a group of lines, each identified with a color. All layers will be listed in the ***Linework layers*** dialog box.

1. To display desired layers on the Main Screen, select the layer and press **Show**, "Yes" displays in the *Show* column. Press **Show** again to hide the layer on the Main Screen; "No" displays in the *Show* column.
2. Press **Ok** to return to the Main Screen (Figure 5-25).

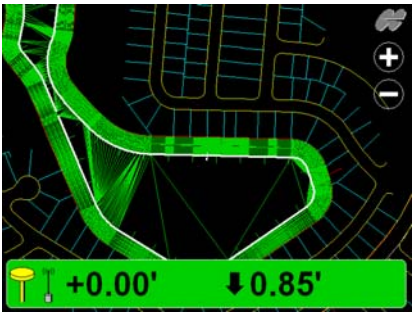


Figure 5-25. Linework Display – Main Screen

Point Display Options

When using a Point file, press **Topcon Logo ▸ View ▸ Display options ▸ Points** to display the ***Points*** dialog box (Figure 5-26). Select a layer and then the information to show for points in that layer.

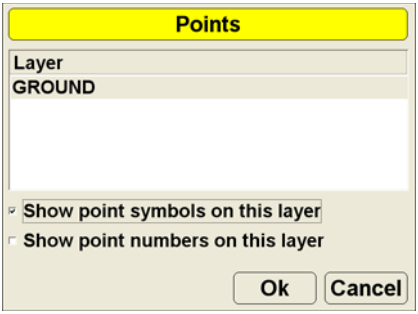
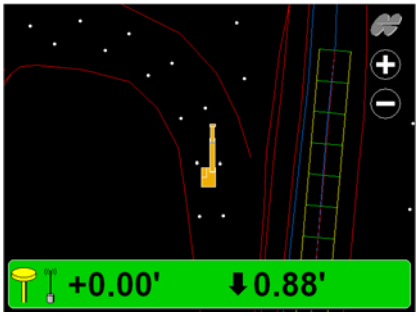
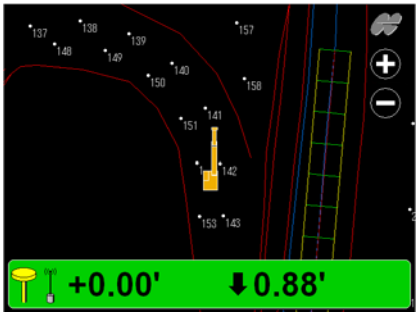


Figure 5-26. Points Display Options

This dialog box has the following selections:

• Show point symbols on this layer – displays all points for the selected layer on the Main Screen. Active measure points also display while performing the Topo Survey function.	
• Show point numbers on this layer – displays the point numbers over the symbols for each point. The numbers will display while in the Topo Survey function.	

Changing the Background Color

1. To change the background color of the Main Screen, press **Topcon Logo ▸ View ▸ Display options ▸ Background color** to display the ***Color Selection*** dialog box.
2. Select a color from the ***Color Selection*** dialog box and press **Ok** to apply the change.

Display Units Options

To set the type of units used in the job, press **Topcon Logo ▸ View ▸ Display options ▸ Display units** to display the ***Display Units*** dialog box (Figure 5-27).

Use this dialog box to change the type of units displayed on the screen or update preset units in the files currently being used. Note that any conversion will not affect grade accuracy.

- Distances – select either Meters, US survey feet, or International feet. Also select the number of decimal places, from zero to four.
- Angles – select either DDº MM'SS", NDDº MM'SS", or Gons.
- Grades – select either Percent (%) or Run : Rise.
- Stations – select either 100.000, 1+00.000, or 10+0.000.
- Volumes – select either Cubic meters or Cubic yards.
- Coordinates – select either North-East-Elev, East-North-Elev, or X-Y-Z.

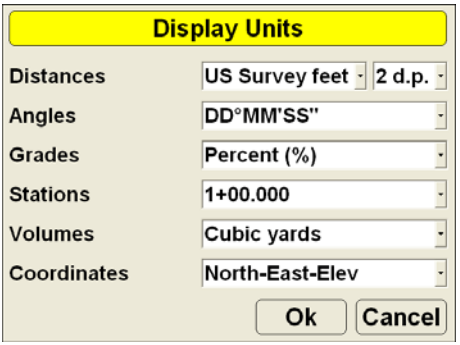


Figure 5-27. Display Units Dialog Box

Viewing GPS Information

To view the ***GPS information*** dialog box and tabs, press the **Elevation control** key, then press the **GPS info** button (Figure 5-28).

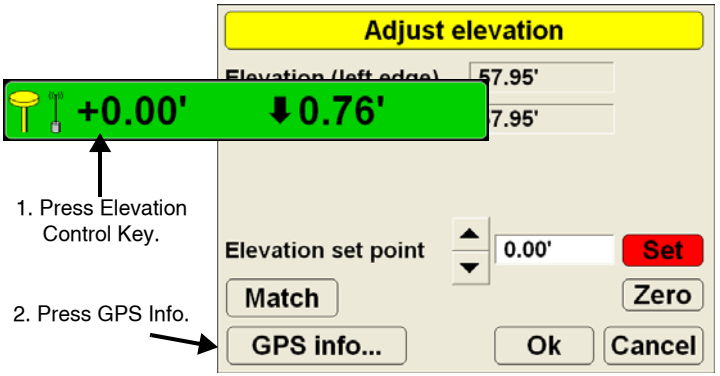


Figure 5-28. View GPS Information

The following sections describe the ***GPS information*** tabs.

Viewing GPS Status and Quality

The *Fix* tab displays satellite status and positioning quality based on GPS satellites currently being tracked (Figure 5-29). Once a GPS solution is initialized, the GX-60 control box reports the Fix status. The positioning quality is an estimation computed from valid satellite status (RMS: Root Mean Square).

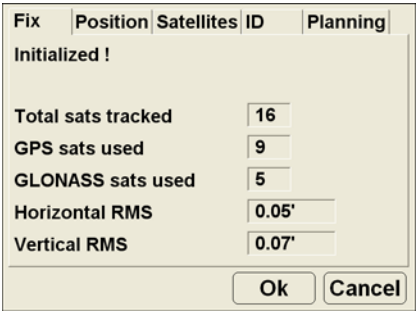


Figure 5-29. GPS Info – Fix Tab

Viewing the Cutting Edge Position

The *Position* tab displays the current location of the left and right sides of the cutting edge (Figure 5-30). These values are based on the local site coordinates, providing quick position and elevation checks at particular points on the project.

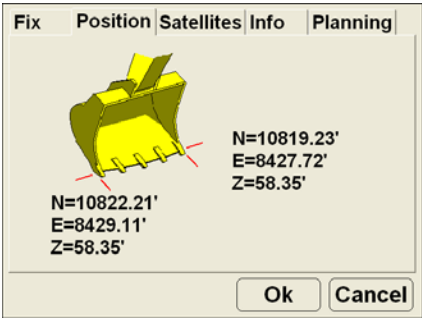


Figure 5-30. GPS Info – Position Tab

Viewing Satellite Location and Changing the Mask Angle

The *Satellites* tab displays the current location of all available GPS satellites (Figure 5-31). Blue dots are GPS satellites, red-with-cross dots are GLONASS satellites, and black dots are unused satellites.

To set or change the mask angle, tap the **Mask angle** entry field and enter the angle of degrees above the horizon to track satellites above (usually 15), and press **Ok**. The red circle will change accordingly.

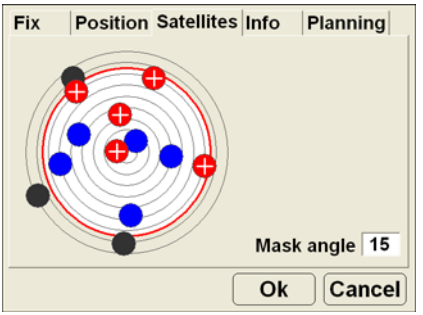


Figure 5-31. GPS Info – Satellites Tab

Viewing Receiver Information and Resetting the Receiver/RTK

The *ID* tab displays identification and firmware revision level for the internal GPS receiver of the MC-2.5 Box (Figure 5-32). It also displays radio link information (type, latency, and quality).

- The Reset RTK key resets RTK ambiguities.
- The Reset receiver key clears all data and resets all settings stored in the GPS receiver (that is, it clears the NVRAM).

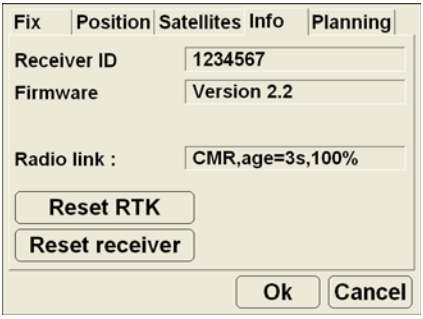


Figure 5-32. GPS Info – ID Tab

Viewing Satellite Planning Information

The *Planning* tab displays the estimated grading precisions on an hourly scale (Figure 5-33 on page 5-26). The **Next** key displays the chart for the next day; the **Prev** key displays the chart for the previous day.

This tab provides useful information for predicting GPS solution accuracy for grading. The red vertical line marks the current time.

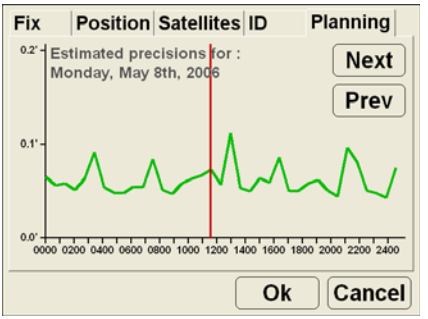


Figure 5-33. GPS Info – Planning Tab

Copying Files

You can copy any of the file types from a USB storage device to the GX-60 control box, and vice versa.

The example below uses the ***Control point files*** dialog box, but any Control point, Surface, Alignment, Linework, Points, or Machine Configuration file can be copied.

1. Insert a USB device into the USB port on the control box, and turn on the control box.

NOTICE

Occasionally, the GX-60 control box may not properly detect the USB device into the USB port during a hot-swap procedure. If this occurs, simply turn off and restart the control box.

---

2. When the 3DMC main screen displays, click **Topcon Logo ▸ File** and then the desired file type (Figure 5-34 on page 5-27).
3. Press **Copy** to display the ***Copy files*** dialog box.
   - To copy from the USB storage device to the control box, select "from data card to internal disk" from the *Copy* drop-down list, then select the Design Surface file from the displayed files (Figure 5-34 on page 5-27).

- To copy from the control box to the USB storage device, select “from internal disk to data card” from the *Copy* drop-down list.

4. Tap the desired file from the displayed files and press **Ok** to begin the copy process. An hourglass displays, indicating that the system is busy.

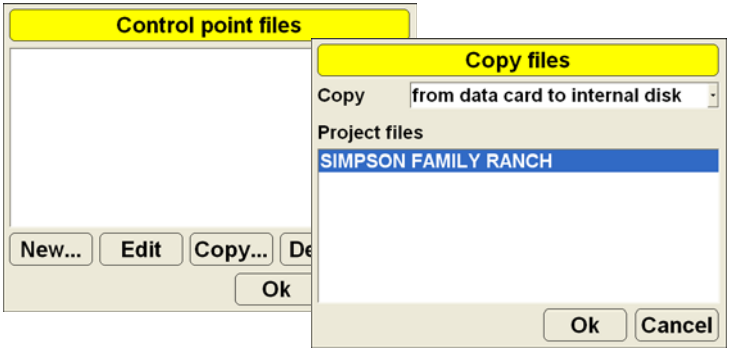


Figure 5-34. Select File To Copy

Changing Radio Channels

If needed, you can use the GX-60 control box to change the radio channel of the radio modem in the MC-2.5 Receiver Box.

Some radio modems, such as Teledesign and Spread Spectrum, have an automatic channel scanning feature, allowing them to detect and connect with the Base Station without having to manually select the radio channel using the GX-60 control box.

Since the MC-2.5 receiver box stores radio settings, including the radio channel, follow the steps below to change the radio channel setting.

1. Tap **Topcon Logo ▸ Tools ▸ Configure radio**.
2. On the ***radio setup*** dialog box (Figure 5-35 on page 5-28), press **Configure** (if available) to run the radio setting program.

The program may take a few seconds to a few minutes to connect to the radio module and check the current setting.

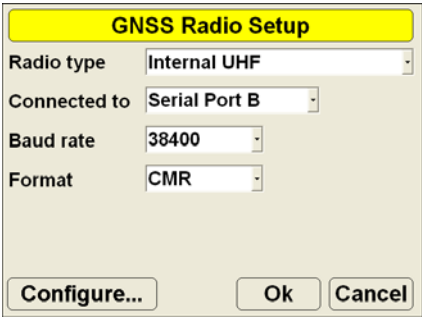


Figure 5-35. Run Radio Setting Program

When the current setting is confirmed, the radio's channel and frequency information displays (Figure 5-36).

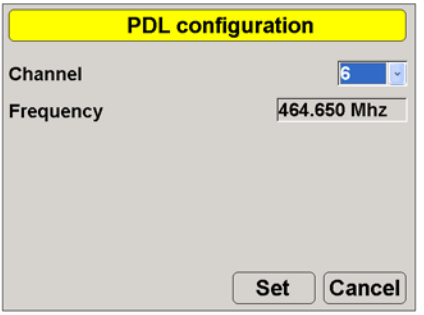


Figure 5-36. Radio Configuration Information

3. Press the *Channel* drop-down list to select the desired channel number. The frequency of the channel changes automatically depending on the selected channel.
4. Press **Set** to activate and save the new radio channel setting. The radio setting program may take a few seconds to a few minutes to program and complete the process.

If you have difficulty connecting to the radio module when changing radio configurations, disconnect the radio antenna cable at the MC-2.5 Box. The Base Station radio can interfere with the machine's radio when making changes.

Steering and Grading to Polyline

The GX-60 control box can be used to steer the machine to a polyline and cut to a polyline layered in the Linework file. Typically, you use an Alignment file to cut along an alignment line. The polylines represent features or objects such as building pads, curbs, sidewalks, top and toe of slopes, or any boundary on the project. If the polyline is composed of three dimensional information at each transition point, it can be selected on the Main Screen and used as the alignment line to steer to, or can be used as the Design Elevation to control the cutting edge.

Setting the Steer Indication

1. Press **Topcon Logo ▸ Control ▸ Steer indication**.
2. Select and enter the following information; the selected alignment for the job also displays.
   - Point of interest – a location on the bucket to steer by.
   - Alignment feature – a feature of the alignment to steer to
   - Additional steer offset – an offset from the feature to apply
   - Light bar green zone – the on-grade portion of the lightbar
3. Press **Ok**.

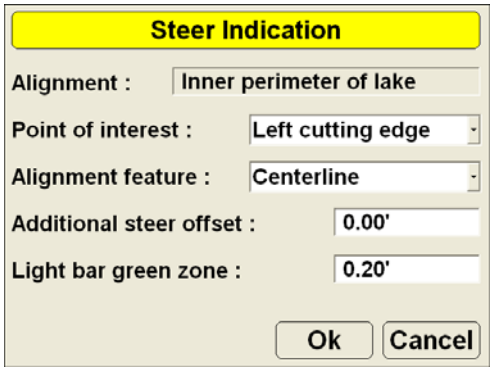


Figure 5-37. Set Steer Indication

Steering to Polyline

1. Press **Topcon Logo ▸ Linework** and select the correct Linework file. Press **Ok**.
2. Press **Topcon Logo ▸ View ▸ Display options ▸ Linework** and select the polylines to display. Press **Show**. See “Linework Display Options” on page 5-20 for more information.
3. View the steering light bar and left section view:
   - **Topcon Logo ▸ View ▸ Lower window ▸ Light bar**
   - **Topcon Logo ▸ View ▸ Left window ▸ Section**
4. Tap the polyline to use for steering on the Main Screen, and tap **Steer to polyline** on the pop-up menu; graphical cross lines display along the selected polyline.

   Figure 5-38 shows an example of the Main Screen after completing the above steps. In this example, the machine needs to move left 1.80'.

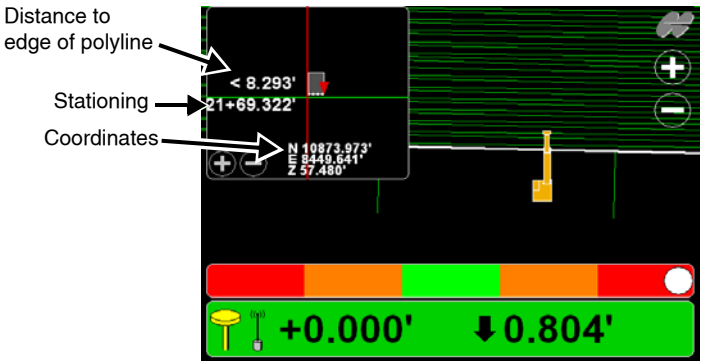


Figure 5-38. Steer To Polyline

5. Press **Topcon Logo ▸ View ▸ Display options ▸ Alignment** to change the interval between cross lines and the steering indication (Figure 5-39).

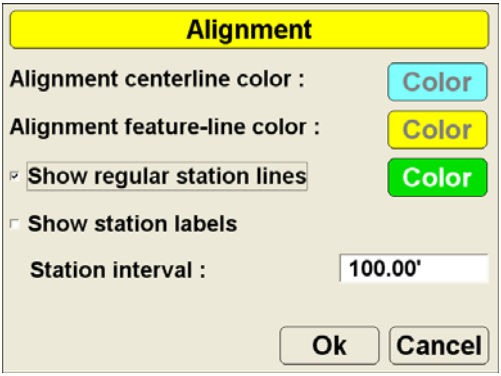


Figure 5-39. Polyline Alignment Options

6. To change to another polyline to steer to, repeat step 4 on page 5-30.
7. To change the alignment file, tap **Topcon Logo ▸ File ▸ Alignments**. The polyline currently being used is substituted as "Polyline alignment" in the file list, select the new Alignment file you want to use and press **Ok**.

Grading to Polyline

1. Press **Topcon Logo ▸ Linework**, select the correct Linework file, and press **Ok**.
2. Press **Topcon Logo ▸ View ▸ Display options ▸ Linework**, select the polylines to display, and press **Show**. See "Linework Display Options" on page 5-20 for more information.
3. Tap the polyline to use for grading and tap **Grade to polyline** on the pop-up menu; graphical cross lines display along the polyline (Figure 5-40 on page 5-32).

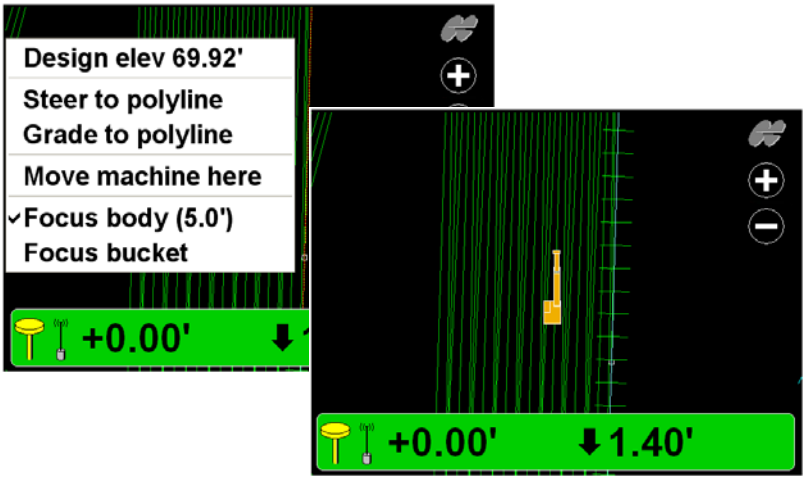


Figure 5-40. Grade To Polyline

Performing Topographic Surveys

3Dxi has the ability to do an "on the fly" topographic survey of the whole project, or any portion thereof. This is helpful when creating as-build to determine the amount of material to move.

1. Tap **Topcon Logo ▸ File ▸ Point files** to display the ***Point files*** dialog box. Create a new point file or select an existing Point file. Press **Ok** to return to the Main Screen.
2. Tap **Topcon Logo ▸ Tools ▸ Topo survey** to display the ***Topo survey*** dialog box (Figure 5-41 on page 5-33), enter or select the following information, and press **Ok**:
   - Log by – select either minimum distance or time interval:
     – Minimum distance: measures each point at a set distance from the previous logged point.
     – Time interval: measures points at a constant time interval.
   - Minimum distance – available when minimum distance selected; enter the minimum distance by which to log points.

- Time interval (secs) – available when time interval selected; enter the time interval in seconds in which to log points.
- Log to layer – stores measured points to the selected layer.
- Log at – determines the measurement point relative to the cutting edge.
- Lower all elevations by – used when keeping the blade a certain distance above ground to prevent the cutting edge from digging into the surface. Manually measure the height between the ground and the target position on the cutting edge, then tap the entry box to display the numeric pop-up keyboard, enter the measured height value, and press **Ok**. Use a positive value when the cutting edge is above the design surface.

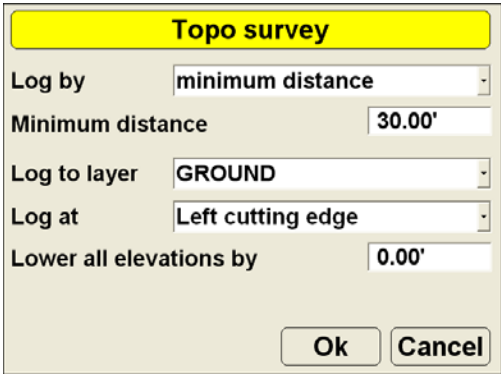


Figure 5-41. Topo Survey Options

3. Press **Ok** to start logging measurement data. When the machine begins to move, it will begin measuring and logging the data.
4. To stop topo measurements, press **Topcon Logo ▸ Stop topo survey** (Figure 5-42 on page 5-34). Otherwise, 3Dxi continues logging measurements.

Measurement data will be saved in the Point file currently being used.

5. Copy the point file to a USB device for office analysis.

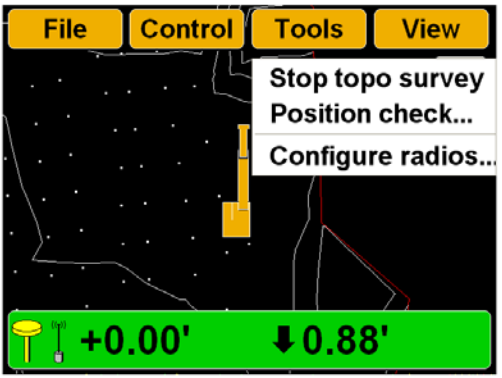


Figure 5-42. Stop Topo Survey

Clearing the MC 2.5 Box NVRAM

The receiver's Non-Volatile Random Access Memory (NVRAM) holds data required for satellite tracking, such as ephemeris[1] data and receiver position. The NVRAM also keeps the current receiver's settings, such as active antenna input, elevation masks and recording interval, and information about the receiver's internal file system.

Even though clearing the NVRAM is not a common (nor normally a recommended) operation, there are times when clearing the NVRAM can eliminate communication or tracking problems. Clearing the NVRAM can be interpreted as a "soft boot" of your computer.

After clearing the NVRAM, your receiver will require some time to collect new ephemerides and almanacs (around 15 minutes). Clearing the NVRAM of the MC-2.5 Box will reset the box to factory default values.

In addition, the NVRAM is used to keep information about the receiver file system. Note that after clearing the NVRAM, the

1. Ephemeris (ephemerides): A table giving the coordinates of a celestial body at a number of specific times during a given period.

receiver's LED(s) will flash orange for a few seconds indicating that the receiver is scanning and checking the file system.

1. Turn off power to the MC-2.5 Box using one of the following:
   - If the MC-2.5 Box is connected to the control box, turn off the control box.
   - Unplug the power cable from the MC-2.5 Box.
2. Simultaneously press and hold the **Main FN** (Figure 5-43) and **AUX FN** keys.
3. Return power to the MC-2.5 Box using one of the following:
   - If the MC-2.5 Box is connected to the control box, turn on the control box.
   - Plug the power cable from the MC-2.5 Box.

   The LED corresponding to the pressed FN key turns green.
4. Wait until the Main LED blinks orange (about three seconds).

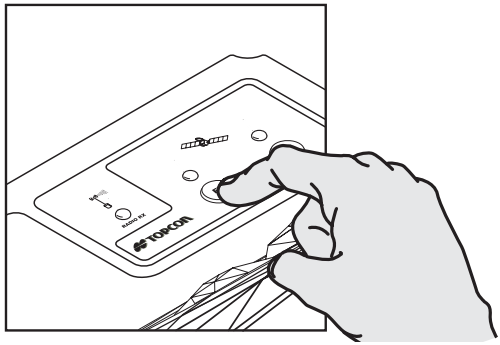


Figure 5-43. Hold FN Key While Turning PWR On to Clear NVRAM

5. Release the FN key while the LED blinks orange.

Notes:

Maintenance & Troubleshooting

Good daily care, preventive maintenance, and routine maintenance will prevent many problems before they occur.

Daily Care

The following guidelines provide for trouble-free operation:

- Keep all carrying cases clean and dry. Do not leave it open and exposed to the elements. Clean and dry all components prior to placing them into the carrying case.
- Ensure that protective connector caps, provided on some components, are in place when not using the cables. Water accumulating on the connectors can cause electrical shorts.
- Do not use high-pressure spray, water, or steam cleaner hoses directly on cables and components. The components can be used in the rain or light spraying.
- Check for loose components due to physical damage.
- Use proper battery supplies for components isolated from the machine (such as the Base Station). Keep the machine's battery in good condition.

Preventive Maintenance

Preventive maintenance will help to keep your 3Dxi components running smoothly and efficiently.

Touch Screen Display Cleaning

The Touch Screen Display should be cleaned often in order to maintain a quality image and prevent faulty operation.

Keep the front surface of the touch screen free of dirt, dust, fingerprints, and other materials that could degrade optical properties.

Long term contact with abrasive materials will scratch the front surface, and image quality will be detrimentally affected. For best results, use a clean, damp, non-abrasive cloth towel and any commercially available window cleaner to regularly clean the surface. Apply the cleaning solution to the towel rather than the surface of the touch screen. Many touch screens have air vents and are not designed with water tight bezels. Fluid ingress may occur from behind the panel if it is not cleaned properly.

1. Dust the display lightly with a non-abrasive cloth towel.
2. Dampen the towel with water or a very diluted mild/neutral detergent solution.

Never use alcohol, ether, benzene, acetone or any sort of solvent. Do not use a high-pressure spray. Do not spray towards the screen.

3. Wipe residual dust off with the damp towel.
4. Clean any residual detergent solution off by using a cloth dampened with only water. Then wipe water and damp area completely dry around the screen.

Lubricating Quick Removal Knobs

Periodically lubricate the quick removal knobs to prevent galling caused by tightening too strongly or through repetitive use (Figure 6-1).

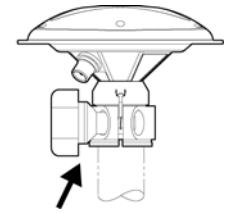


Figure 6-1. Lubricate Knobs (MC-A1 Example)

Simply apply a lubricant, such as normal grease, to the threads of the knob attachment.

Troubleshooting 3Dxi Components

In general, as long as you follow the maintenance and safety instructions provided in this manual, you should have few problems with your 3Dxi™. This section will help you diagnose and solve some common problems you may encounter with the various components.

Before contacting TPS customer support about any problems, try the following and see the following sections:

- Check that the various components (radio, MC-2.5 Box, GX-60 control box, Base Station, etc.) have power and are powered up.
- Check that all cables are securely and properly connected to the various components of the 3Dxi (GX-60 control box, antenna, etc.). See"Jobsite Setup" on page 4-1 for details.
- Disconnect cables and inspect them for damage or contamination. Clean all connections with an electrical contact cleaner.

Do not attempt to repair equipment yourself. Doing so will void your warranty and may damage the hardware.

Base Station

This section lists possible Base Station problems you may encounter (also refer to the Base Station's documentation). If you still have problems after trying the solutions listed here, contact TPS customer support.

Problem	
The GPS receiver does not power on.	
Causes	Solutions
The PWR button was pressed too quickly.	Make sure you hold the PWR button down for at least one second. A quick press will not activate the receiver.

The power cable is incorrectly connected or damaged.	Check that the power cable is correctly connected to the battery—RED to positive and BLACK to negative—and that the battery is charged. Check that the RED dots on the power cable connector and receiver power socket are aligned, and the cable is pushed in. If the power cable is damaged, contact your dealer to replace it.
Problem	
Radio modem does not power on.	
Causes	Solutions
The power cable is incorrectly connected or damaged.	Check that the power cable is correctly connected to the battery—RED to positive and BLACK to negative—and that the battery is charged. If the power cable is damaged, contact your dealer to replace it.
The radio receives power through the Legacy-E+ receiver.	Some radios do not require a separate power supply, but are supplied power through the port on the receiver. For these radios, check that the receiver is on.
Problem	
Pocket-3D does not connect to the GPS receiver.	
Causes	Solutions
The GPS receiver is off.	Check that the GPS receiver is on.
If using a cable, the cable may be incorrectly connected.	Check that the cable is connected to the COM port on the Pocket-3D controller and to Port A on the GPS receiver. Check that the correct receiver is selected in Pocket-3D. If still no connection, reset the controller and repeat the connection.

Problem	
Pocket-3D is waiting for satellites.	
Causes	Solutions
The cable is incorrectly connected or damaged.	Check that the antenna cable is not cross-threaded and is screwed in all the way. If the cable is damaged, contact your dealer to purchase a new cable.
The antenna has poor PDOP.	Check that the antenna has a clear view of the sky.
The receiver is collecting an almanac.	If this is the first time connecting to the GPS receiver, or if an internal reset has recently been performed, this message may persist for several minutes while the GPS receiver obtains a new almanac.
Problem	
Radio modem light is not flashing.	
Causes	Solutions
The cable is incorrectly connected or damaged.	Check that the cable from the receiver is properly connected to the radio. If the cable is damaged, contact your dealer to purchase a new cable.
The radio does not have a TX LED.	Some radios may not have a TX (Transmit) LED so the radio may in fact be functioning.
The radio has a TX LED, but it is not yet flashing.	All radio types specifically listed for the Base Station kit have a TX light and should flash every second. It may take several seconds after connection for this flashing to commence.

MC-2.5 Receiver Box

This section lists possible MC-2.5 Receiver Box problems you may encounter. If you still have problems after trying the solutions listed here, contact TPS customer support.

Problem	
All LEDs off.	
Causes	Solutions
The power cable may be incorrectly connected.	Power is supplied through the cable connected to Serial Port A. Check that the cable is properly connected
The MC-2.5 Receiver Box does not have power.	Power to the MC-2.5 Receiver Box depends on where power is connected to the machine. • If the MC-2.5 power is connected to the GX-60, turn on the control box. • If the MC-2.5 power is connected to the ignition, turn on the ignition.
Problem	
Satellite Status indicator does not flash green.	
Causes	Solutions
The cable is incorrectly connected or damaged.	Check that the antenna cable is not cross-threaded at the antenna and is connected to the intermediate cable installed on the machine. Check the connection at the GPS Antenna port on the MC-2.5 Box. If the cable is damaged, contact your dealer to purchase a new cable.
The antenna has poor PDOP.	Check that the Machine Antenna has a clear view of the sky.

The receiver is collecting an almanac.	If this is the first time connecting to the MC-2.5 Box, the LED may not flash for several minutes while the GPS receiver obtains a new almanac.
Problem	
Radio Status indicator does not flash green.	
Causes	Solutions
The Base Station and/or Base Station radio has a problem.	Check that the Base Station is running correctly and the TX light on the radio modem flashes on.
Different channels are used between the Base Station and the machine.	Check that the Base Station and Machine use the same radio channel. • For the Base Station, use the button on the radio modem or use the "GPS Radio Configuration" program with the Pocket-3D connected. See "Equipment Setup: Base Station" on page 4-1. • For the machine, use the GX-60 control box function. See "Changing Radio Channels" on page 5-27.
The antenna at the Rover or Base may be too low, incorrectly placed, or too far away.	If the green LED flashes when near the Base Station, but not when farther away, check that the machine's radio antenna mast is mounted vertically at the highest point on the machine. If the machine gets too far from the Base Station, elevate the radio antenna at the Base Station or move it to a closer Control Point.

GPS Localization

This section lists possible GPS localization problems you may encounter.

Problem	
Measurement takes too long.	
Causes	Solutions
The machine may be blocking satellite signals to the range-pole or tripod-mounted antenna.	Watch the status of the measurement screen. If the status indicates “waiting for satellites” move the machine away from the antenna.
The Control Point may be located too close to obstructions.	Move to an alternative Control Point or have the surveyor place a new Control Point away form the obstructions.
The MC-2.5 Box has not yet initialized; the system may be tracking many satellites.	The MC-2.5 Box may take several minutes to initialize.
The range-pole was unsteady.	Make sure that the pole is held steady while measurement is taking place. Any movement will make for a lengthy initialization and/or measurement.
Problem	
Localization produces large errors.	
Causes	Solutions
A typographical error occurred.	If errors are 10s or 100s of feet or meters, it is likely that a typographical error has occurred. If coordinates are manually entered, check that longitudes are correctly prefixed with a minus sign if working in the western hemisphere (for example, USA). Re-enter the coordinates.

The range-pole was unsteady.	If the errors are decimeter level in magnitude, it may point to either inaccurately measured local site coordinates or not holding the range-pole vertical when measuring the GPS coordinates.
Inaccurate local site coordinates or erroneous GPS measurement.	If error values of the first few points are reasonable but increase when a new point is measured, the point just measured must have either inaccurate local site coordinates or erroneous GPS measurement. To isolate the error, disable horizontal and/or vertical localization for each Control Point in turn and observe the set of errors. When the errors become acceptable due to certain isolation, the point isolated is most likely to detract from the quality of the localization. Also, as a general rule, if error values of the first few points are reasonable but increase when a new point is measured, the point just measured must have either inaccurate local site coordinates or erroneous GPS measurement. Once a problematic Control Point is discovered, try to re-measure the point again to see any improvement. If it is still suspect and affects the acceptable tolerance, the horizontal and/or vertical localization for this point may be disabled.

Problem	
There are no H.Error and V.Error values.	
Causes	Solutions
"Use for horizontal GPS localization" and/ or "Use for vertical GPS localization" check boxes may not have been selected.	These check boxes need to be selected for a minimum of three points. Note that the error value will be calculated once three Control Points are measured and used for the GPS localization. This troubleshooting is useful when the Pocket-3D is being used to perform GPS localization as well as the GX-60 control box.

GX-60 Control Box

This section lists possible GX-60 control box problems you may encounter.

Problem	
The control box does not power on.	
Causes	Solutions
The cable is the wrong cable, incorrectly connected, or damaged.	Check that the power cable supplies 12 to 24 VDC. • A and B sockets = power • C and D sockets = ground Check that the power cable is connected to the correct port (see "GX-60 Control Box Features" on page 2-1) and the ends are securely fastened. If the cable is damaged, contact your dealer to purchase a new cable.

Problem	
Screen has transferred to operating system.	
Causes	Solutions
"Exit 3DMC" function may have been pressed unexpectedly or incorrectly.	Look for the "3DMC" icon and double-tap on it. The application program will open and return to the Main Screen.
Problem	
"Control file has no GPS localization" message.	
Causes	Solutions
Not enough Control Points used for localization.	Press **Ok** to exit the message screen. Check that the Control Points file used has a minimum of three localized points. Perform the localization process again.
No GPS localization has been performed for the project.	Plan to implement the GPS localization. See "GPS Localization" on page 4-19 for detailed instructions.
Problem	
"Loading…." or "Building…." message.	
Causes	Solutions
3DMC is in the middle of loading files or making graphics.	If the pointer on the Main Screen moves when you tap in different places, 3DMC is computing. When the system is busy, the pointer becomes an hourglass. Wait for a few more minutes to let it complete the process. Remember, computing will take longer when a larger file is selected.

If the pointer does not move, the control box may have a computing problem.	Switching off the control box can fix the computing problem.
Problem	
Elevation Control key displays: “GPS receiver not connected!”	
Causes	Solutions
Either the GPS signal or radio signal is invalid. The graphic may indicate what causes the problem.	For GPS signal, check cable connections along the GPS antenna cable from the GPS Antenna port on the MC-2.5 Box to the Machine Antenna. Check connections at the System Five-3D port on the MC-2.5 Box and Connector A on the control box.
Problem	
Elevation Control key displays: “Waiting for radio link”.	
Causes	Solutions
Radio transmission, radio antenna, lights status on the GPS receiver, and/or power may have a problem.	Check that the Base Station is working correctly. See “Base Station” on page 6-4 to troubleshoot Base Station problems. Also check that the Machine Radio Antenna on the machine and its cable connections are properly connected. Make sure that the radio channel is identical between the Base Station and the Machine, and that the radio is correctly configured on the Control Computer. For more information, see “Equipment Setup: Base Station” on page 4-1 and “Machine Setup” on page 4-9.

Problem	
Elevation Control key displays: “Waiting for Initialization”.	
Causes	Solutions
The GPS receiver has not been successful tracking enough valid satellites.	Check that the Machine Antenna has a clear view of the sky. Check for obstructions, such as trees, buildings, and vehicles, that can block or reflect satellite signals.
The system is still in the process of determining a solid position.	If this is the very first time for operation, this message may persist for several minutes while the Legacy-E+ obtains a new almanac.
Problem	
Elevation Control key displays: “Out of design area”.	
Causes	Solutions
The machine is out of the Design Surface area.	Make sure that the correct Control Point File and Design Surface file is selected. Move into the Design Surface area so the operator can start grading.
Problem	
Elevation Control key displays: “No GPS localization”.	
Causes	Solutions
The Control Points file currently selected has not been localized properly.	Make sure that the correct Control Points file currently is selected.
You are in a process of building a Control Point file or just starting the process.	Disregard the message until the localization is complete. See “GPS Localization” on page 4-19 to perform localization.

Problem	
Elevation Control key displays: “Slope Sensor Offline”.	
Causes	Solutions
A TS-1 has become disconnected (unplugged).	Check all cable connections going to the various TS-1 sensors on the body, boom, stick, dog-bone (optional), quick coupler (optional), and bucket (optional if using a quick coupler).

Notes:

TS-1 Calibration

The TS-1 sensors provide lateral and longitudinal angle measurements, regardless of the object's position in space. The sensors accurately measure the position of the body, boom, stick and bucket, sending this angle data to the GX-60 control box to provide precise grade and slope. Each sensor is configured and calibrated for its specific location on the excavator.

Refer to the *3Dxi Installation and Calibration Manual* for specific details. The following sections are the chapter three from this manual.

Before calibrating TS-1 sensors, note the following:

When the system if first powered on, it may take several minutes for the GX-60 to discover (detect) each sensor.

Check sensor serial numbers before installing. The last two digits of the serial number determine the sensor CAN address, and must be unique to each machine.

For example, sensor serial number 0302 and 0402 will have the same CAN address ("02"), causing communication errors.

Also, serial numbers ending with 00 or 01 may cause communication conflicts.

Unless otherwise noted, each step of the calibration process must be performed individually and in order. That is, steps should not be combined or performed out of order.

Performing sensor calibrations as described in this chapter will prevent communication problems.

Measuring Machine Lengths

As accurately as possible, enter the machine dimensions into the 3DMC machine builder (Table A-1). Verification and adjustment for several critical lengths are described the *3Dxi Installation and Calibration Manual*.

NOTICE

Incorrect measurements or data entry errors have a direct affect on grading accuracy.

Take each measurement twice to ensure accuracy.

Table A-1. Machine Measurements

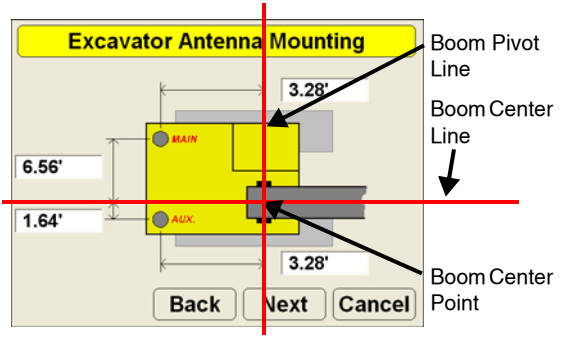
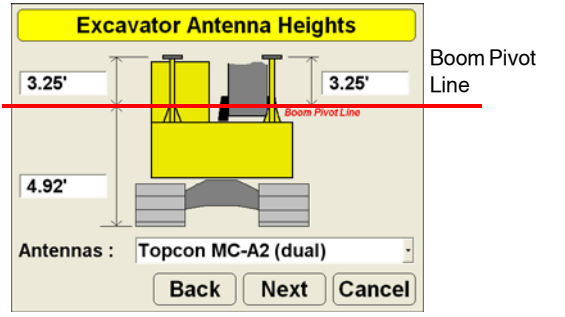
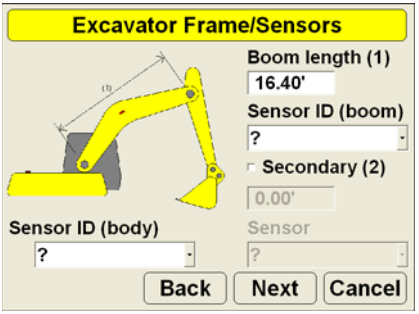
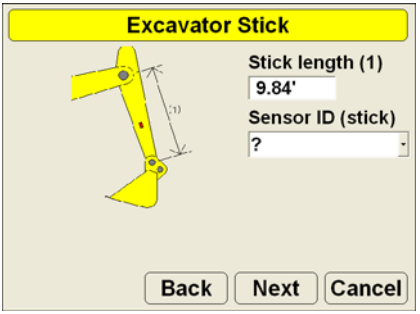
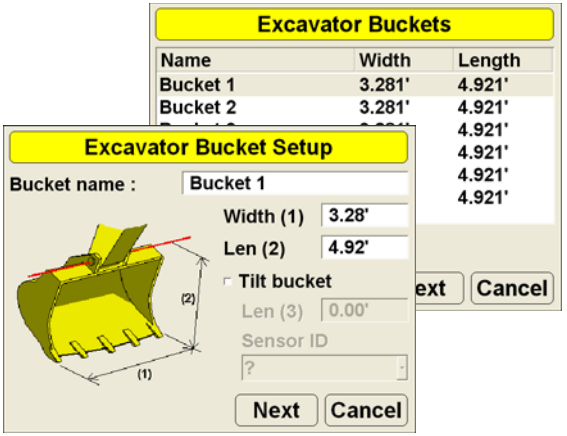
Measurements To Take	Screen Shot
Antenna Positions	
Antenna Heights	

Table A-1. Machine Measurements (Continued)

Measurements To Take	Screen Shot
Boom Length	
Stick Length	
Bucket Width and Length (repeated for each bucket)	

Entering Sensor Information

Before calibrating the sensors on a 3Dxi system, set up each sensor in 3DMC. You will need the following information:

- the last three digits of the sensor's serial number
- the physical orientation of the sensor mounting

Step 1: Rename each sensor to easily identify it during the calibration and setup processes.

1. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup.
2. Select a current machine file and press **Edit**, or press **New** to create a new machine file.

   Refer to the *3Dxi Reference Manual* for further information on creating a machine file.
3. Press **Next** to navigate to the Excavator Frame/Sensors screen.
4. Tap any Sensor ID box and select the factory ID of the sensor corresponding to the machine element. Tap the Wrench button.

   You may need to select a random ID, then view the serial number on the Sensor Calibration screen to determine the sensor's location. Return to the Excavator Frame/Sensors screen and select another sensor. Repeat until the correct sensor is selected.

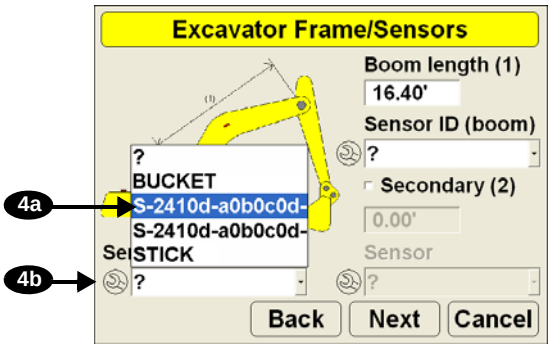


Figure A-1. Select Factory Sensor ID

5. Tap the Name box and enter a name the sensor according to its mounting location. Press **Ok**.

The sensor's serial number displays in the screen header.

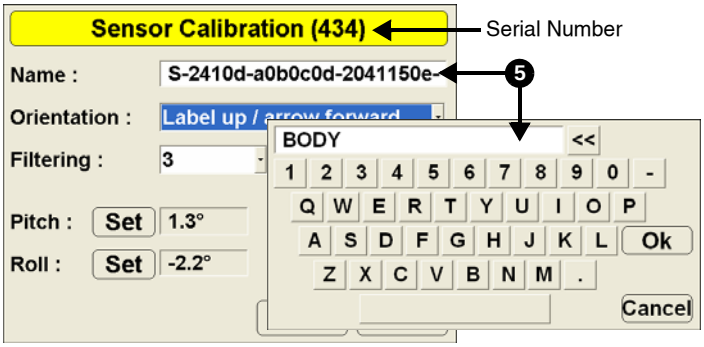


Figure A-2. Enter New Sensor Name

6. Repeat steps 4 and 5 for all remaining frame sensor(s).

You can select any wrench icon to change the name of a sensor. In the next step ("Step 2: Assign sensor IDs" on page A-6), you will assign a sensor to each machine component.

Step 2: Assign sensor IDs to each of the machine elements.

1. Navigate to the Excavator Frame/Sensor screen.
2. Tap the Sensor ID box and select the corresponding sensor for selected machine element.
3. Repeat step 3 for the remaining frame sensor(s).
4. Press **Next** and repeat step 3 for the stick sensor.
5. Press **Next** and repeat step 3 for the bucket sensor.

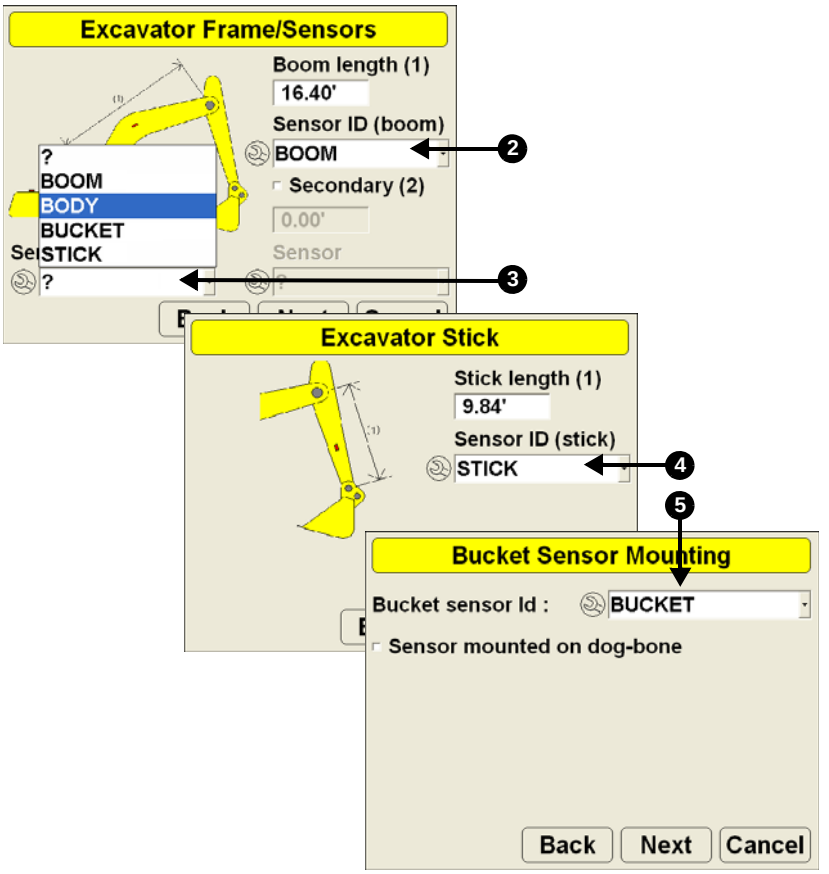


Figure A-3. Select Sensor For Machine Element

Step 3: Set sensor orientations for the machine elements.

1. Navigate to the Excavator Frame/Sensor screen.
2. Tap the Wrench button for the desired sensor.
3. Tap the Orientation box and select the physical orientation of the mounted sensor. Press **Ok**.

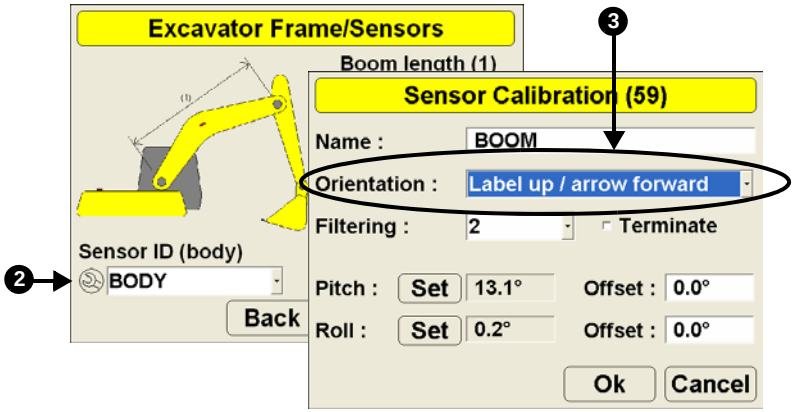


Figure A-4. Select Sensor Orientation

4. Repeat steps 2 and 3 for the remaining frame sensor(s).
5. Press **Next** and repeat steps 2 and 3 for the stick sensor.
6. Press **Next** and repeat steps 2 and 3 for the bucket sensor.

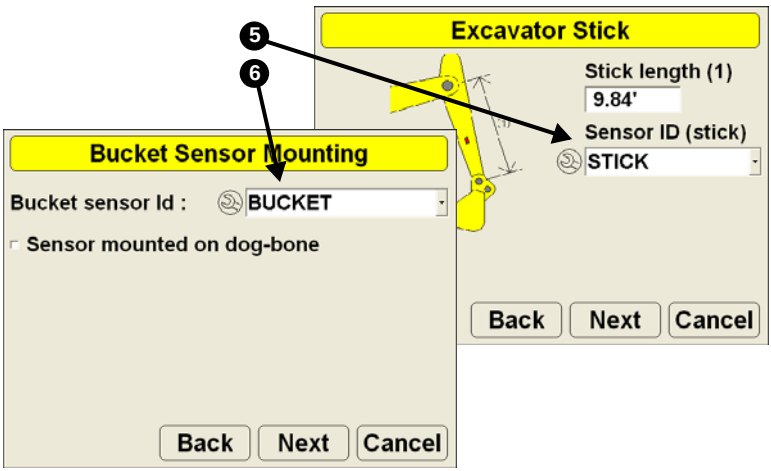


Figure A-5. Enter Sensor Orientation

Calibrating the Sensors

Once the sensors have been named, assigned to a machine element and the orientation selected, each sensor needs to be calibrated using 3DMC. A sensor calibration can be performed at any time.

Body Sensor Calibration

The body sensor calibration requires both the pitch and roll calibrations. Perform both calibrations at the same time to ensure accurate measurements.

> **TIP** Perform the body sensor calibration on a slight slope to make it more obvious that the calibration was completed properly.

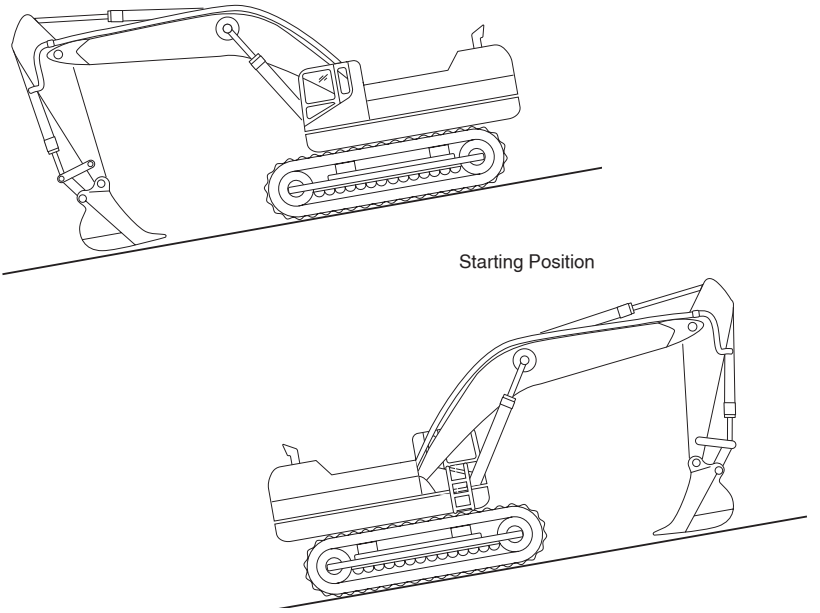


Figure A-6. Body Calibrations for Latitudinal Slope

1. Position the machine on a stable surface free of obstructions.
2. Curl the stick and bucket in as close as possible to reduce tipping errors.

3. Rotate the body parallel to the tracks (position 1).
4. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file for the job and press **Edit**. Press **Next** to navigate to the Excavator Frame/Sensors screen.
5. Tap the Wrench button that corresponds to the body sensor.
6. Set both pitch and roll values to zero.

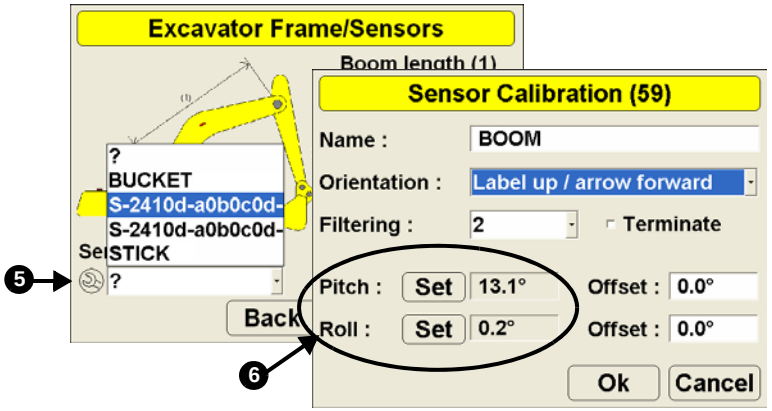


Figure A-7. Set Pitch and Roll Values to Zero

7. Without moving the tracks, rotate the machine 180° (position 2).
8. Set the pitch and roll to half the displayed values (for example, 13.1 / 2 = 6.55 and 0.2 / 2 = 0.1).

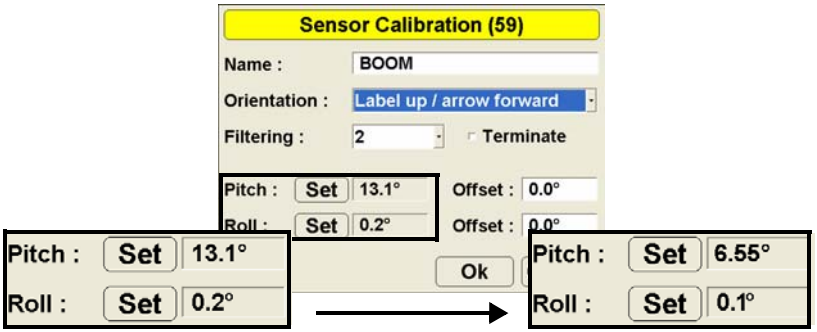


Figure A-8. Set New Pitch and Roll Value to Half

9. Check the Pitch and Roll values in both positions. The two values for each position should be equal, but one will be positive and the other negative.

Boom Sensor Calibration

The boom sensor calibration requires only the pitch calibration. When performing the boom sensor calibration, a total station or laser is required to correctly position the boom at zero degrees.

The installer may prefer to use a different instrument, such as a total station, for this step; however, for simplicity, the following steps illustrate a rotating laser.

1. Position the machine on a stable surface free of obstructions and rotate the body parallel to the tracks.
2. Place a zero slope rotating laser along the side of the machine to shine on both the boom pivot and stick pivot.
3. Adjust the laser height to strike the center of the boom pivot (Figure A-9).
4. Move the boom to align the stick pivot with the laser (Figure A-9).

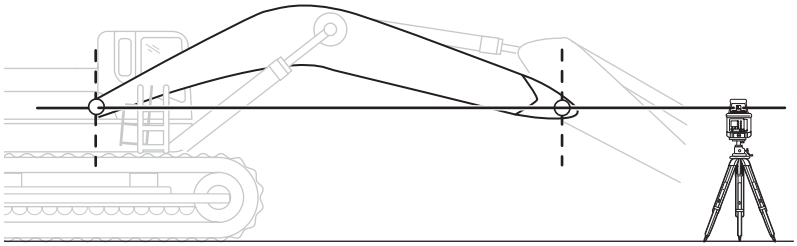


Figure A-9. Place Laser to Strike Center of Boom Pivot

5. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file for the job and press **Edit**. Press **Next** to navigate to the Excavator Frame/Sensors screen.
6. Tap the Wrench button that corresponds to the boom sensor (Figure A-10 on page A-11).
7. Set the pitch to zero and press Ok (Figure A-10 on page A-11).

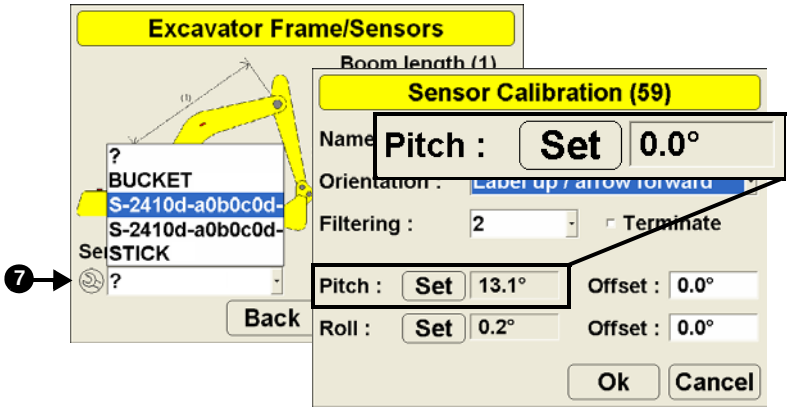


Figure A-10. Set Pitch Value to Zero

8. Navigate through the remaining steps of Machine setup, saving the file and exiting.
9. On the Main Screen of 3DMC, view a profile of the machine and verify that the boom is horizontal.

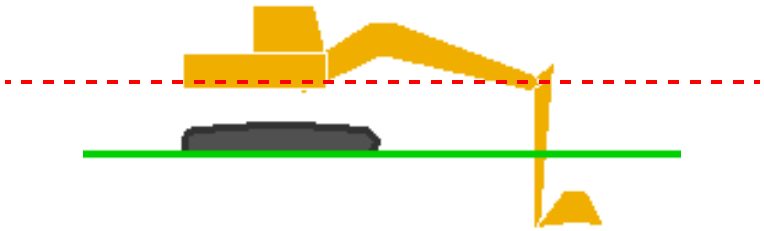


Figure A-11. Verify Position of Boom on Main Screen

Secondary Boom Sensor Calibration (Optional)

Like the primary boom sensor, the secondary boom sensor calibration requires only the pitch calibration. The same method used for calibrating the primary boom sensor is used to calibrate the secondary boom sensor. See “Boom Sensor Calibration” on page A-10 for details.

1. Position the machine on a stable surface free of obstructions and rotate the body parallel to the tracks.
2. Place a zero slope rotating laser along the side of the machine to shine on both the boom pivot and stick pivot.
3. Adjust the laser height to strike the center of the boom pivot.
4. Move the boom to align the stick pivot with the laser.
5. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file for the job and press **Edit**. Press **Next** to navigate to the Excavator Frame/Sensors screen.
6. Tap the Wrench button that corresponds to the secondary boom sensor (Figure A-12).
7. Set the pitch to zero and press Ok (Figure A-12).

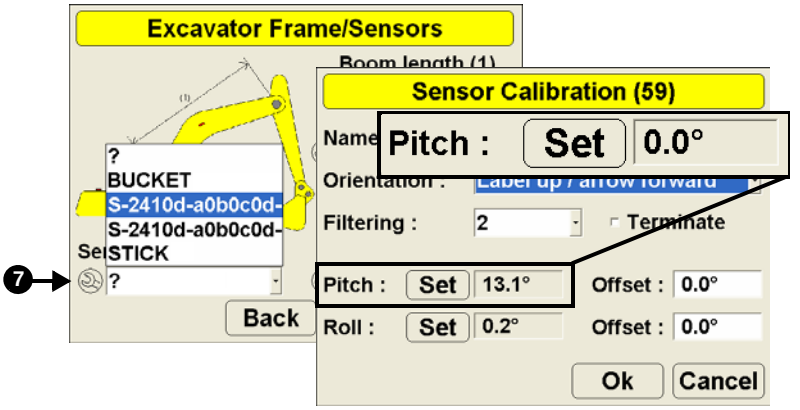


Figure A-12. Set Pitch Value to Zero

8. Navigate through the remaining steps of Machine setup, saving the file and exiting.

Stick Sensor Calibration

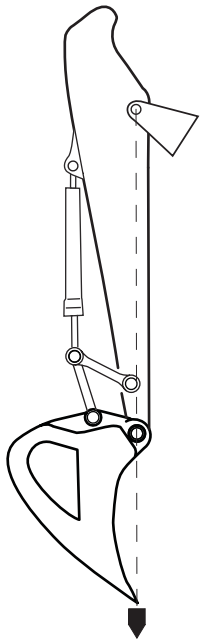
The stick sensor calibration requires only the pitch calibration. When performing the stick sensor calibration, a total station or plumb bob is required to correctly position the stick at zero degrees.

The installer may prefer to use a different instrument, such as a total station, for this step; however, for simplicity, the following steps illustrate a plumb bob.

The plumb setup for both stick and bucket sensor calibrations is the same. Perform both calibrations at the same time to save time.

Unless mounting a sensor to the dog-bone. In this case, perform stick/bucket calibrations separately.

1. Position the machine on a stable surface free of obstructions and rotate the body parallel to the tracks.
2. Attach a plumb bob to the boom-stick pivot.
3. Move the stick to align the bucket pivot with the plumb bob.
4. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file for the job and press **Edit**. Press **Next** to navigate to the Excavator Stick screen.
5. Tap the Wrench button for the stick sensor (Figure A-13 on page A-14).
6. Set the pitch to -90.0 and press Ok (Figure A-13 on page A-14).



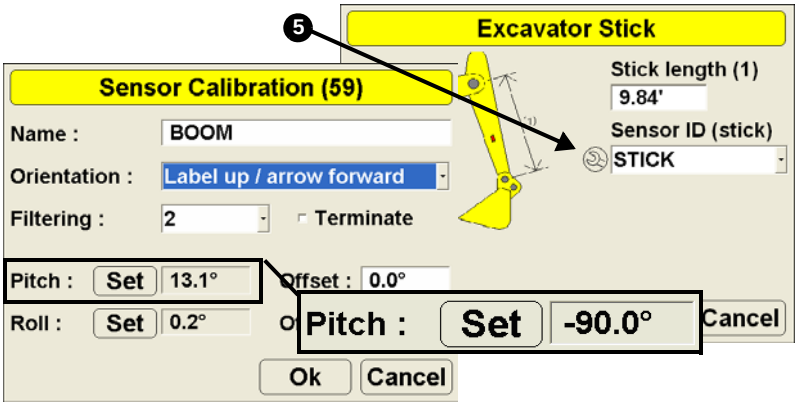


Figure A-13. Set Pitch Value to -90.0

7. Navigate through the remaining steps of Machine setup, saving the file and exiting.
8. On the Main Screen of 3DMC, view a profile of the machine and verify that the stick is vertical.

Figure A-14. Verify Position of Stick on Main Screen

Bucket Sensor Calibration

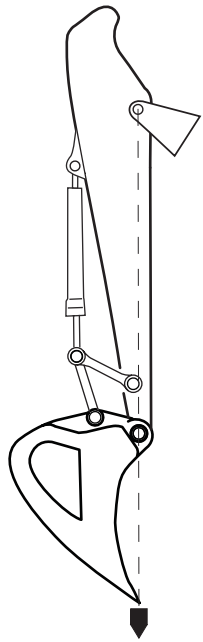
The bucket sensor calibration requires only the pitch calibration. When performing the bucket sensor calibration, a total station or plumb bob is required to correctly position the bucket at zero degrees.

The installer may prefer to use a different instrument, such as a total station, for this step; however, for simplicity, the following steps illustrate a plumb bob.

The plumb setup for both stick and bucket sensor calibrations is the same. Perform both calibrations at the same time to save time.

Unless mounting a sensor to the dog-bone. In this case, perform stick/bucket calibrations separately.

1. Position the machine on a stable surface free of obstructions and rotate the body parallel to the tracks.
2. Attach a plumb bob to the boom-stick pivot.
3. Move the bucket to align the bucket teeth with the plumb bob.
4. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file for the job and press **Edit**. Press **Next** to navigate to the Bucket Sensor Mounting screen.
5. Tap the Wrench button for the bucket sensor (Figure A-15 on page A-16).
6. Set the pitch to -90.0 and press Ok (Figure A-15 on page A-16).



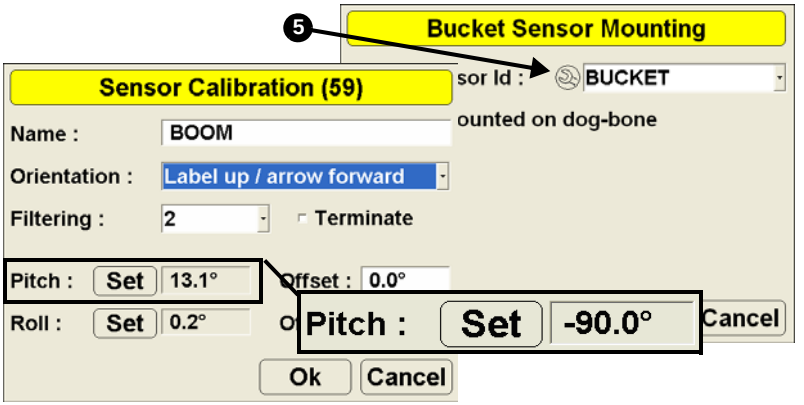


Figure A-15. Set Pitch Value to -90.0

7. Navigate through the remaining steps of Machine setup, saving the file and exiting.
8. On the Main Screen of 3DMC, view a profile of the machine and verify that the bucket is vertical.

Figure A-16. Verify Position of Bucket on Main Screen

9. If this is the last sensor physically connected to the machine, see “CAN Termination” on page A-24.

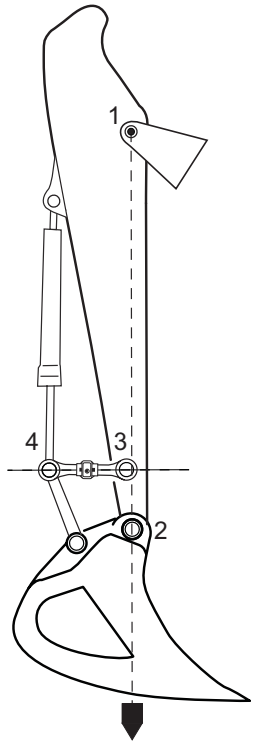
Dog-bone Sensor Calibration

The dog-bone sensor calibration requires only the pitch calibration. When performing the dog-bone sensor calibration, a total station or plumb bob is required to correctly position the dog-bone at zero degrees.

The installer may prefer to use a different instrument, such as a total station, for this step; however, for simplicity, the following steps illustrate a plumb bob.

The dog-bone calibration compares the stick sensor to the dog-bone sensor to determine bucket angle. The stick sensor must be properly calibrated before attempting the dog-bone calibration.

1. Position the machine on a stable surface free of obstructions and rotate the body parallel to the tracks.
2. Attach a plumb bob to the boom-stick pivot.
3. Move the stick to align the bucket pivot with the plumb bob.
4. Move the bucket so the dog-bone is horizontal (points 3 and 4 in the figure at right).
5. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file for the job and press **Edit**. Press **Next** to navigate to the Bucket Sensor Mounting screen.
6. Tap the Wrench button for the bucket sensor (Figure A-17 on page A-18).



7. Set the pitch to zero and press Ok (Figure A-17).

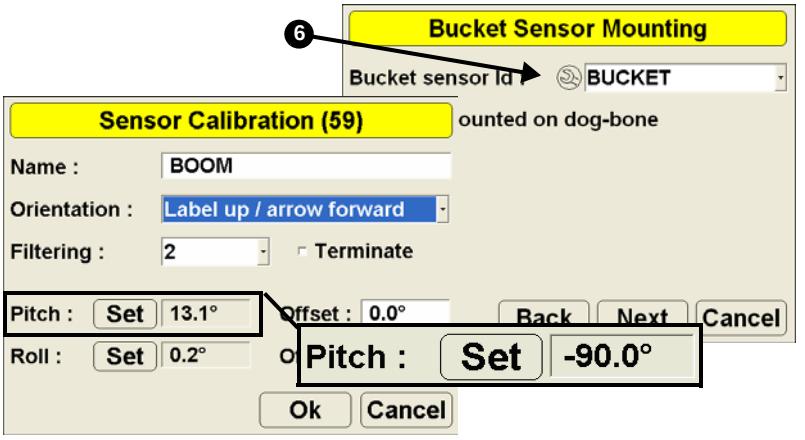


Figure A-17. Set Pitch Value to Zero

8. On the Bucket Sensor Mounting screen, check that "Sensor mounted on dog-bone" is selected and tap Next.
9. Measure and enter the four lengths of the dog-bone joint, then press Calibrate (Figure A-18).

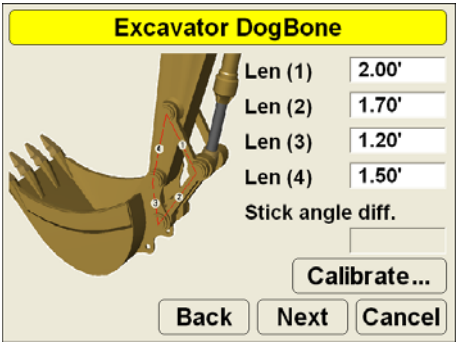
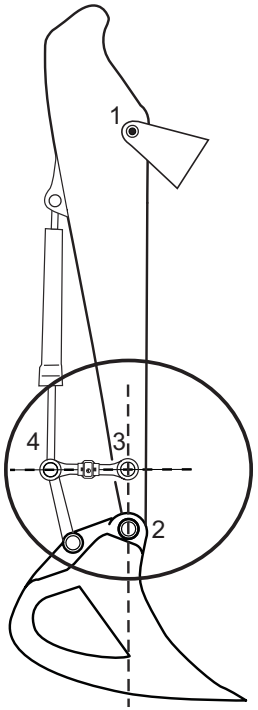


Figure A-18. Determine Stick Angle Difference

10. Move the stick approximately vertical. Position the total station directly to the side of the stick to reduce parallax error.

11. Align points 2, 3, 4 with the cross hair of the total station as follows:
    - Move the stick to align points 2 and 3 with the vertical cross hair.
    - Adjust the total station to place the horizontal cross hair on point 3.
    - Move the bucket so point 4 is also on the horizontal cross hair.

    All three points should be aligned on the cross hairs as shown in figure at right.



12. Enter 90 for Angle (1) and press Ok (Figure A-19).

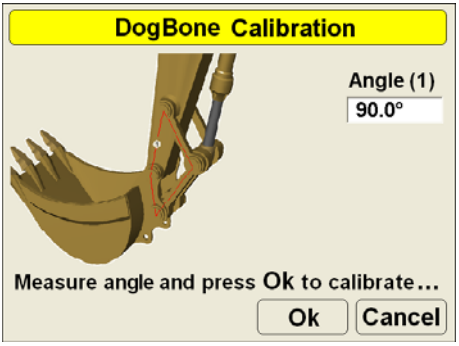
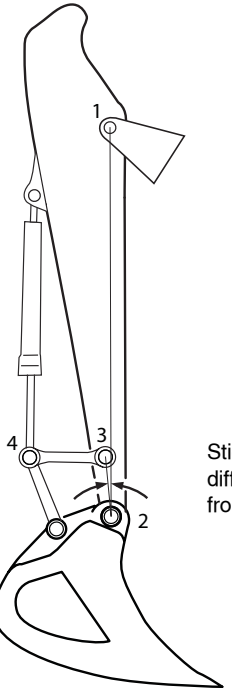
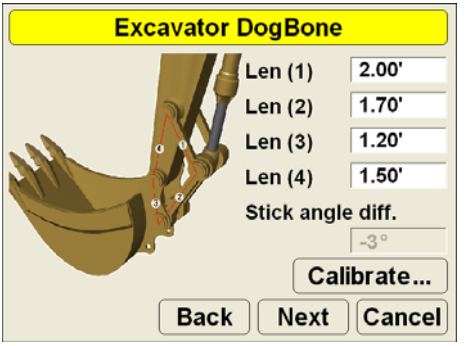


Figure A-19. Determine Stick Angle Difference

The *Stick angle difference* box will display the angle of points 1-2-3 and should be less than 10 degrees (Figure A-20). This will vary by machine geometry.





Stick angle difference calculated from points 1-2-3

Figure A-20. Verify Position of Bucket on Main Screen

After completing the dog-bone calibration, calibrate the bucket to vertical as seen in “Multiple Bucket Calibration” on page A-21.

13. Navigate through the remaining steps of Machine setup, saving the file and exiting.
14. After completing the dog-bone calibration, calibrate the bucket to vertical as seen in “Multiple Bucket Calibration” on page A-21.
15. If this is the last sensor physically connected to the machine, see “CAN Termination” on page A-24.

Multiple Bucket Calibration

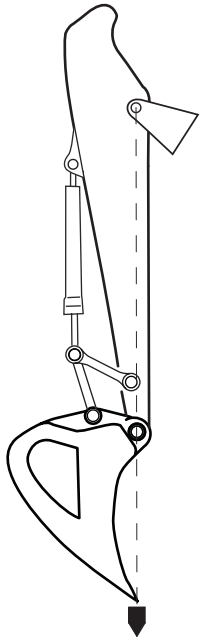
If a using a quick change coupler to switch buckets, the geometry difference between buckets must be determined. Once loaded into 3DMC, the bucket can be quickly selected on the fly. When calibrating multiple buckets, only the bucket's measurements will differ for standard buckets.

Only the geometry difference between buckets will need to be calculated. The calibration process as seen in "Bucket Sensor Calibration" on page A-15 will remain the same for the sensor.

When performing the bucket sensor calibration, a total station or plumb bob is required to correctly position the bucket at zero degrees.

The installer may prefer to use a different instrument, such as a total station, for this step; however, for simplicity, the following steps illustrate a plumb bob.

1. Position the machine on a stable surface free of obstructions and rotate the body parallel to the tracks.
2. Attach a plumb bob to the boom-stick pivot.
3. Move the bucket to align the bucket teeth with the plumb bob.
4. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file for the job and press **Edit**. Press **Next** to navigate to the Excavator Buckets screen.
5. Press Edit and enter the bucket width and length; change the name if desired. Press Next (Figure A-21 on page A-22).



If setting up a tilt bucket, select the option. Enter the distance from the bucket to the tilt joint. Tap the Wrench button and enter sensor information as described in “Entering Sensor Information” on page A-4. Then press Next.

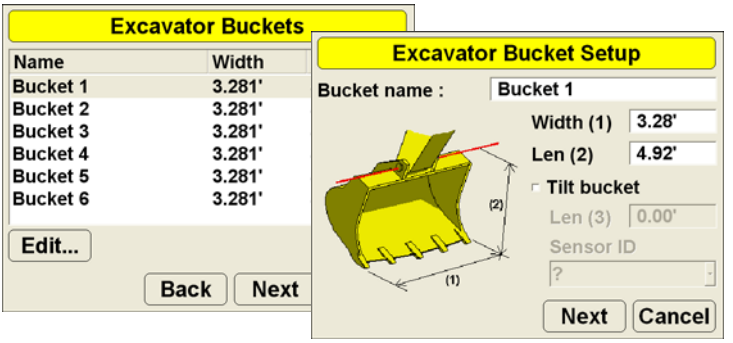


Figure A-21. Edit Bucket Measurements

6. With the bucket plumb, press Calibrate. Press Ok at the confirmation. When done, press Next.

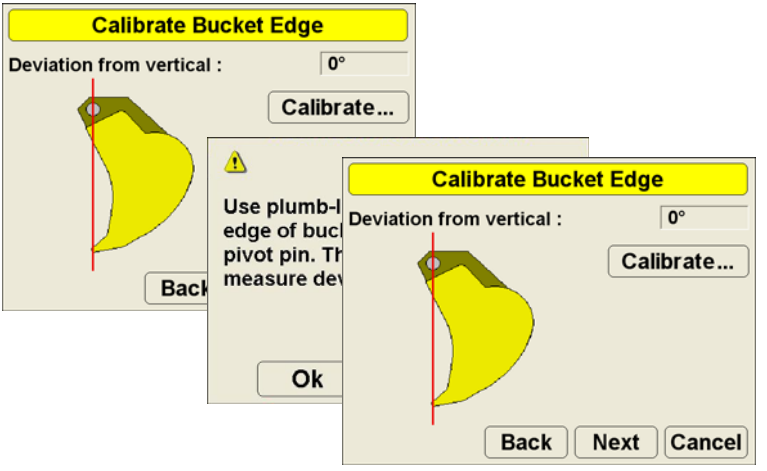


Figure A-22. Calibrate Bucket Edge

7. Move the bucket horizontally, checking that the pivot and base are level. Press Calibrate then Ok at the confirmation. When done, press Finish.

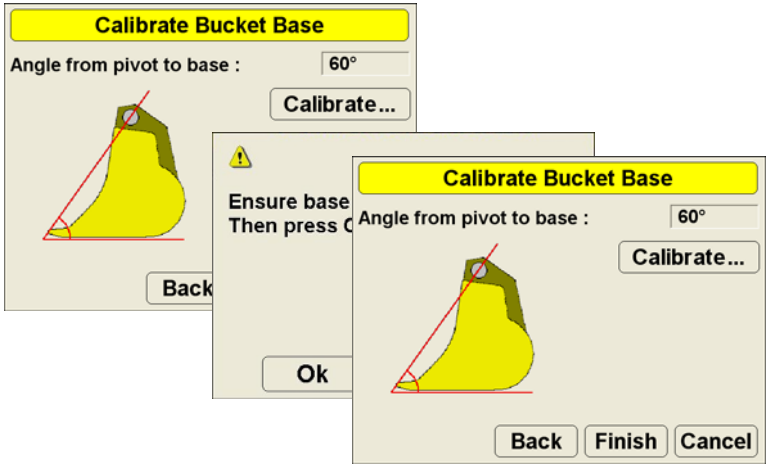


Figure A-23. Calibrate Bucket Base

8. On the Main Screen of 3DMC, view a profile of the machine and verify that the bottom of the bucket is flat on the ground.

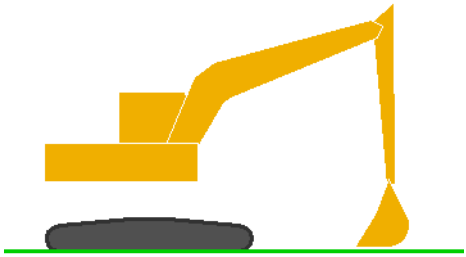


Figure A-24. Verify Position of Bucket on Main Screen

9. Repeat these steps for all desired buckets. After saving the machine file, use the Topcon Logo ▸ Control ▸ Bucket menu to change the bucket used in 3DMC.

CAN Termination

To ensure proper communication between the sensors and the GX-60, the last sensor physically connected must have CAN termination. Typically, this will be the bucket sensor (or the tilt bucket sensor).

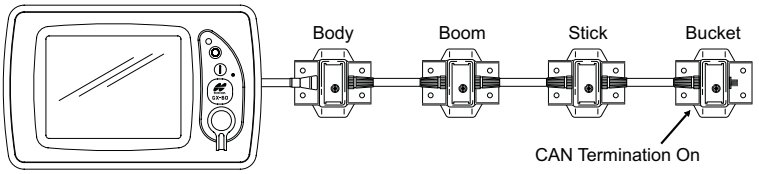


Figure A-25. Sensor Furthest from GX-60 gets CAN Termination

1. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file and press **Edit**. Press **Next** to navigate to the (bucket) sensor screen.
2. Tap the Wrench button for the sensor furthest from the GX-60 (Figure A-26).
3. Select and turn on Terminate (Figure A-26).

Do not select this option for more than one sensor. Only select this option for the last sensor.

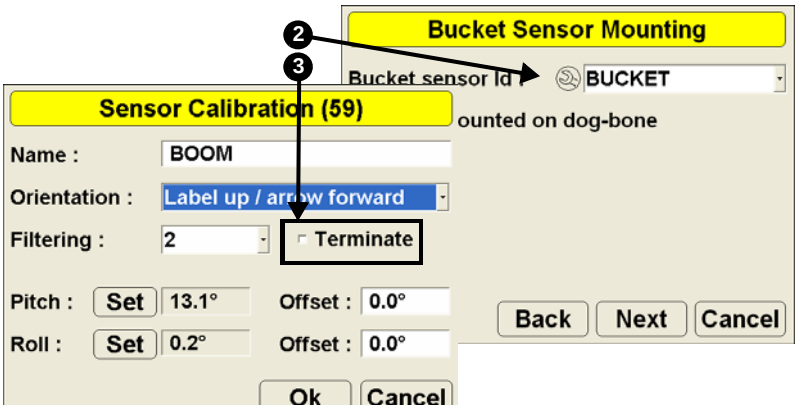


Figure A-26. Set CAN Termination for Last Sensor (Bucket Sensor)

4. Navigate through the remaining steps of Machine setup, saving the file and exiting.

Sensor Filtering

The filter level for each sensor can be changed depending on the application and operator's choice. A value of 4 (Heavy) will dampen sensor reaction, while a value of 1 (Light) will cause faster sensor reaction. The default filter level is 2.

1. In 3DMC, tap Topcon Logo ▸ Control ▸ Machine setup. Select the applicable machine file and press **Edit**. Press **Next** to navigate to the desired machine element sensor screen.
2. Tap the Wrench button for the desired sensor GX-60 (Figure A-27).
3. Select a filtering level and press Ok (Figure A-27).
4. Navigate through the remaining steps of Machine setup, saving the file and exiting.

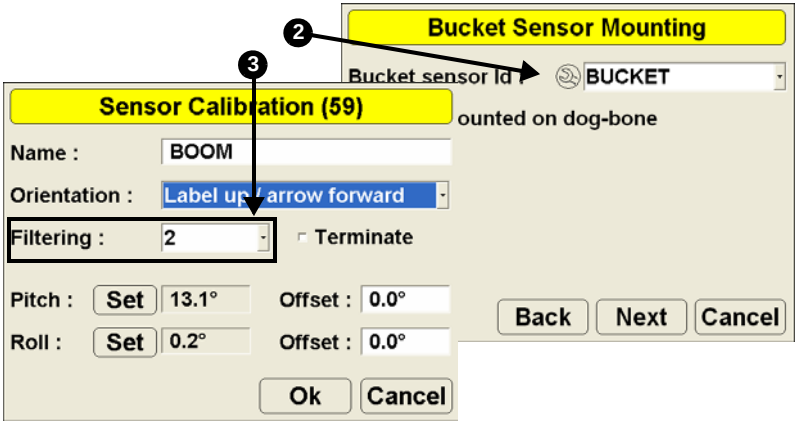


Figure A-27. Set Filtering Level (Bucket Sensor)

Notes:

Pocket-3D Getting Started Guide

Pocket-3D is grade and staking control software for hand-held controllers. At the jobsite, Pocket-3D provides a way to make quick changes and updates to files, double-check control points, initialize the GPS base, and many other useful functions.

3DMC and Pocket-3D save files in the same format, making it simple to share files and updates between surveyors, machine operators, grade checkers, etc.

Refer to the *Pocket-3D User's Manual* and *Pocket-3D Reference Manual* for further details.

Before performing any Pocket-3D configuration or application function, check the units used at the job. Units are the method of measurement used for measuring various data. To check, change, or apply units to the project, tap **Setup** ▸ **Units** (Figure B-1).

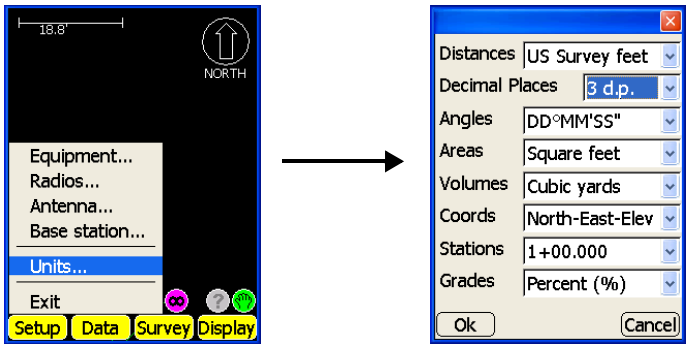


Figure B-1. Setup Units

Equipment Setup: GPS

Equipment setup consists of jobsite files to ensure correct data is used for positioning activities and a machine file to ensure the correct measurements are taken.

Step 1: Create a Control Point File

First, create a control point file (Figure B-2):

1. Tap **Data** ▸ **Control** ▸ **[<none> or file name]**.
2. Tap **New** to create a control point file.
3. Enter a name for the file and press **Ok**.
4. Select the control point file and press **Ok**.
5. Press **Yes** to apply the file to the jobsite.

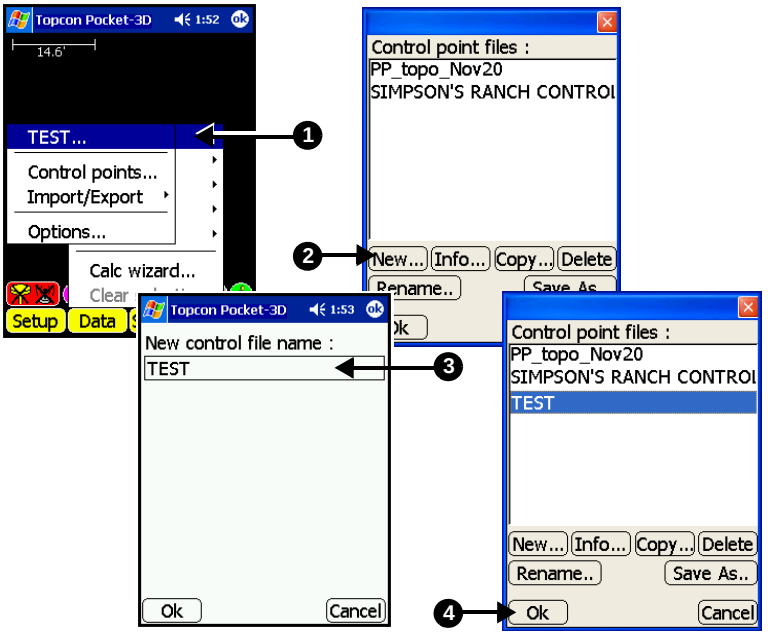


Figure B-2. Create a Control Point File

Then, enter control point data into the file (Figure B-3):

1. Tap **Data** ▸ **Control** ▸ **Control points**.
2. Tap **Add** to enter the local coordinates for the control point.
3. Enter a name and description for the control point and its local coordinates. Press **Ok**.
4. Repeat steps 2 and 3 for each control point.
5. Press **Ok** to save the data.

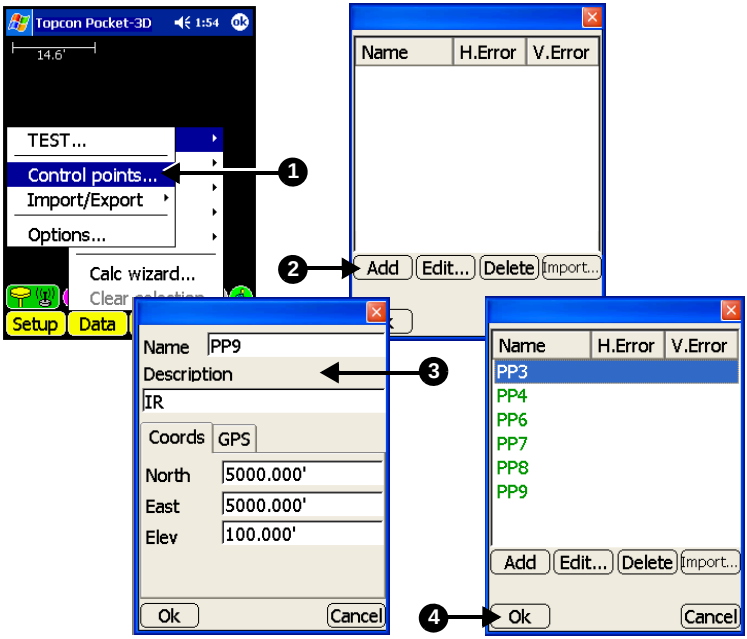


Figure B-3. Enter Control Points

Step 2: Setup and Initialize a Base Station

For a GPS Base Station, enter antenna and radio information (Figure B-4):

1. Connect the controller and receiver. Tap **Setup ▸ Base station**.
2. Select the control point over which the base station is installed and the connection between controller and receiver. Press **Next**.
3. Enter antenna type and height information. Press **Next**.
4. Enter radio type and communication information. If using a Pacific Crest PDL UHF radio, press **Configure** to select channel information and press **Set**. Press **Next**.
5. Select GPS receiver settings. Press **Finish** to initialize the GPS receiver and start the Base.
6. Immediately disconnect the Pocket-3D controller from the receiver. Performing any other activities while connected will convert the Base to a Rover.

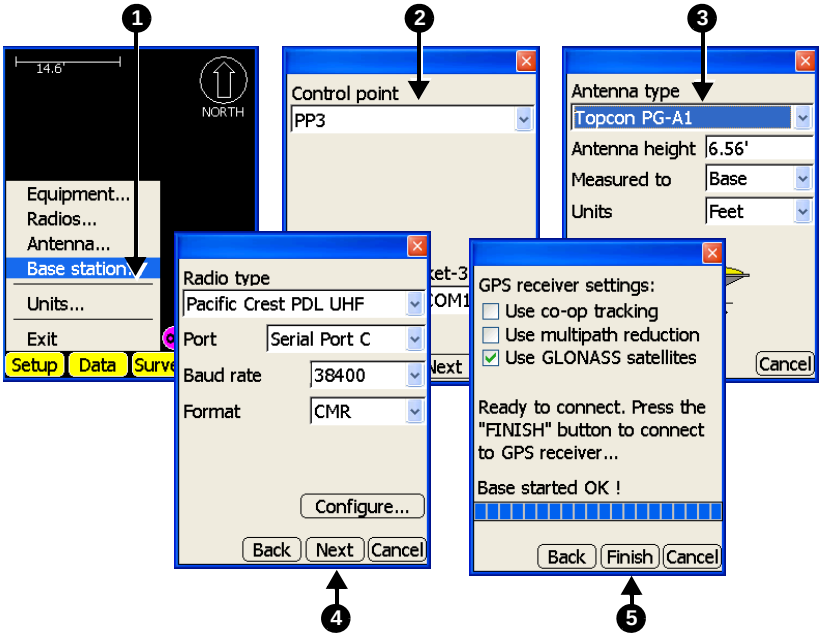


Figure B-4. Enter Base Station Information and Start Base

Step 3: Create a Range Pole Equipment Configuration

Pocket-3D creates an equipment configuration for a range-pole Rover (Figure B-5 to Figure B-7). A Rover can be used to check and verify grade.

1. After initializing the Base, connect the Pocket-3D controller to the Rover GPS receiver. Tap **Setup ▸ Equipment**.
2. Tap **New**. Enter a configuration name and equipment information. Press **Next**.

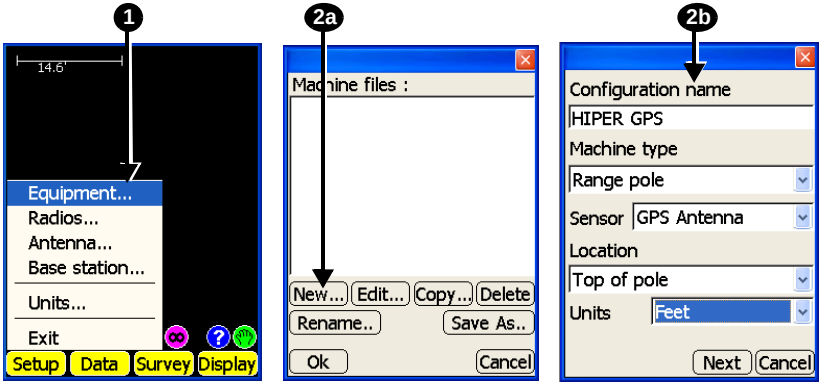


Figure B-5. Enter Configuration Type

3. Enter antenna information for the range-pole. Press **Next**.
4. Enter radio information. Press **Next**.

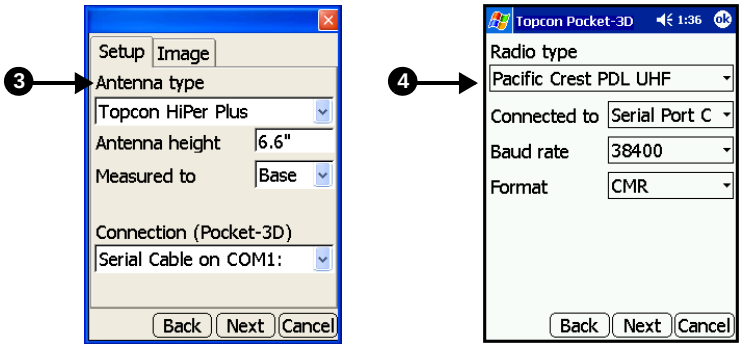


Figure B-6. Enter Antenna Information and Measurements

5. Select the configuration and press **Ok**. Press **Yes**.

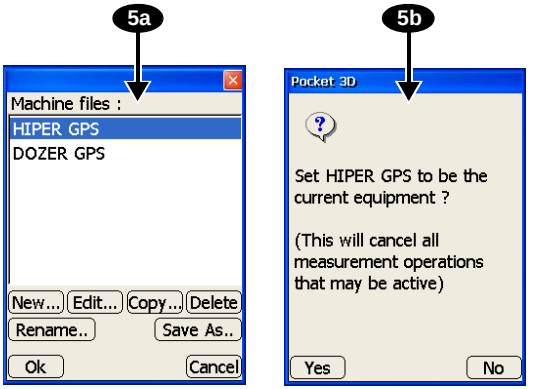


Figure B-7. Enter Radio (and mmGPS Information); Set As Equipment

Step 4: Setup the Rover Radio

Configuring the range pole Rover radio (Figure B-8) ensures proper communication with the Base.

1. Tap **Setup** ▸ **Radios**.
2. Select the radio type and enter its communication settings. If needed, press **Configure** to select the channel.
3. Press **Ok**.

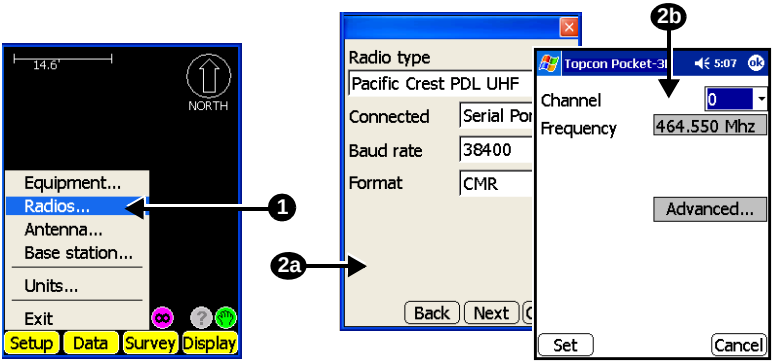


Figure B-8. Enter Radio Parameters

Step 5: Setup the Rover Antenna

Setup the Rover antenna's type and measurements (Figure B-9).

1. Tap **Setup** ▸ **Antenna**.
2. Select the type of antenna and enter its measurement information. Press **Ok**.

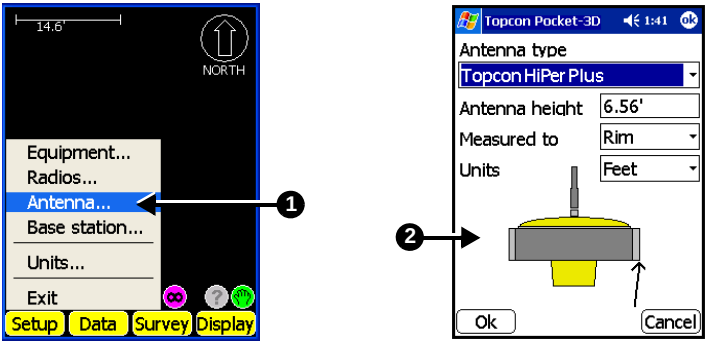


Figure B-9. Enter Antenna Information for GPS+ (or mmGPS Rover)

Step 6: Connect to the Rover

After setting up the rover, connect to the GPS receiver to begin using Pocket-3D at the jobsite (Figure B-10 on page B-8).

1. On the main screen, tap the **GPS setup** button.
2. Once the connection has been established, press **Ok**.

Notice that the GPS setup button changes color from red to green, indicating successful communication between the Base and Rover.

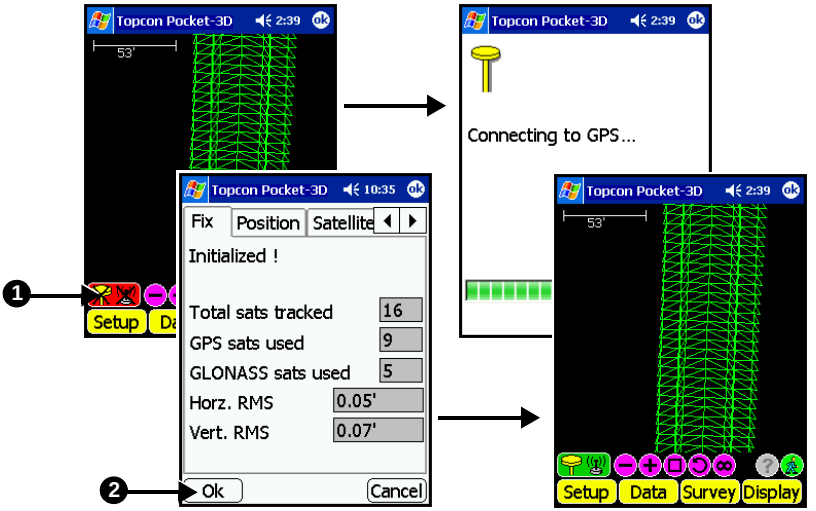


Figure B-10. Connect to GPS

Localizing with Pocket-3D

After setting up the Base Station, localize the jobsite coordinates with GPS+ coordinates.

1. Ensure the control point file for the jobsite is selected (**Data ▸ Control**) and select the equipment configuration for the current setup (**Setup ▸ Equipment**) (Figure B-11 on page B-9).
2. Tap **Data ▸ Control ▸ Control points**. Select the point to edit and press **Edit**.
3. Check the local coordinates and press the **GPS** tab.

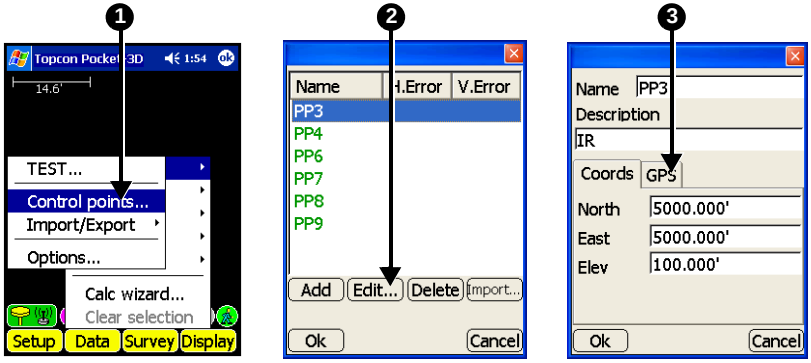


Figure B-11. Select Control Point to Localize

4. Enable "Use horizontal" and "Use Vertical" and press **Measure**. Press **Ok** to save the measurement (Figure B-12).
5. Repeat steps 2, 3, and 4 for each control point.
6. View the results and press **Ok** to save the control point file.

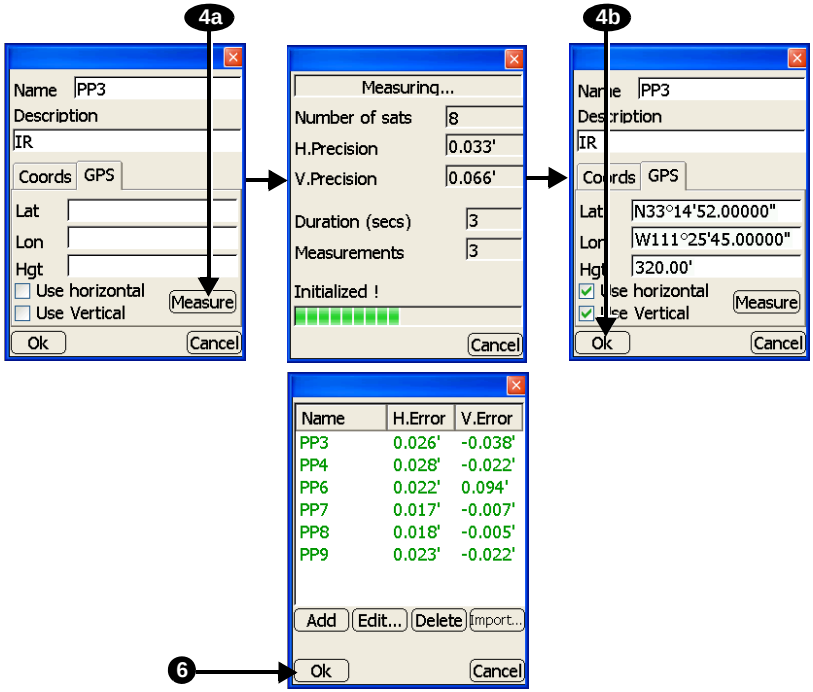


Figure B-12. Localize Control Points

Creating Files in Pocket-3D

In preparation for collecting point and polyline data, create a points file and a linework file for the jobsite.

Creating a Points File

1. Tap **Data** ▸ **Points** ▸ **[<none> or file name]**. Press **New**.
2. Enter a name for the points file and press **Ok**.
3. Press **Layers**.

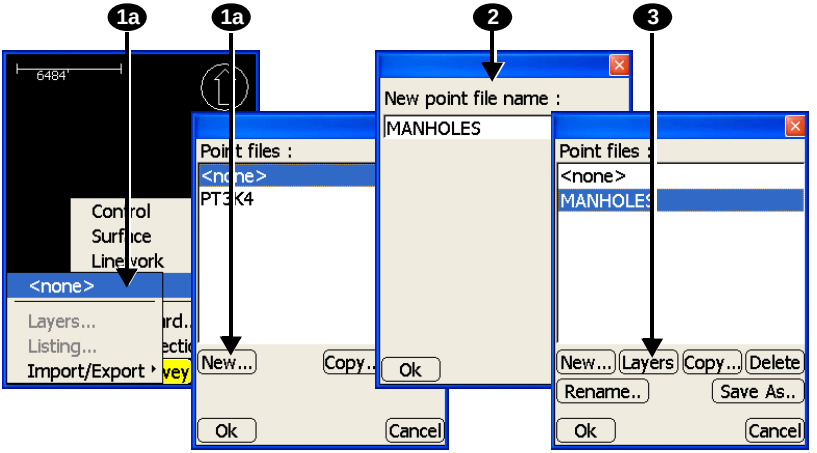


Figure B-13. Create Points File

4. Press **New**. Enter a name for the layer and the layer's parameters. Press **Ok** (Figure B-14 on page B-11).
5. Repeat step 4 for any other layers.
6. Press **Ok** to save the file. Press **Yes** to apply the file to the current jobsite.

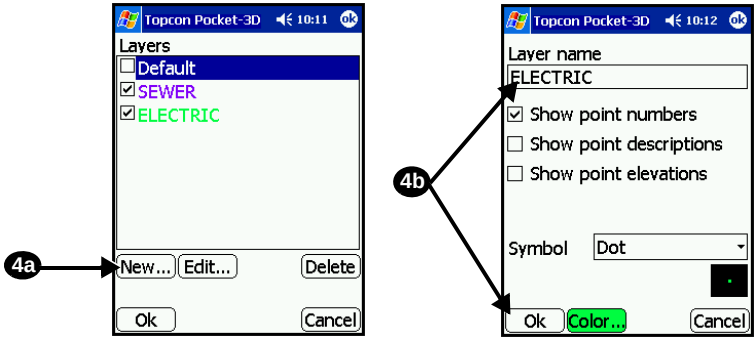


Figure B-14. Add Layers to Points File

Creating a Linework File

1. Tap **Data** ▸ **Linework** ▸ **[<none> or file name]**. Press **New** (Figure B-15).
2. Enter a name for the linework file and press **Ok**.
3. Press **Layers**.

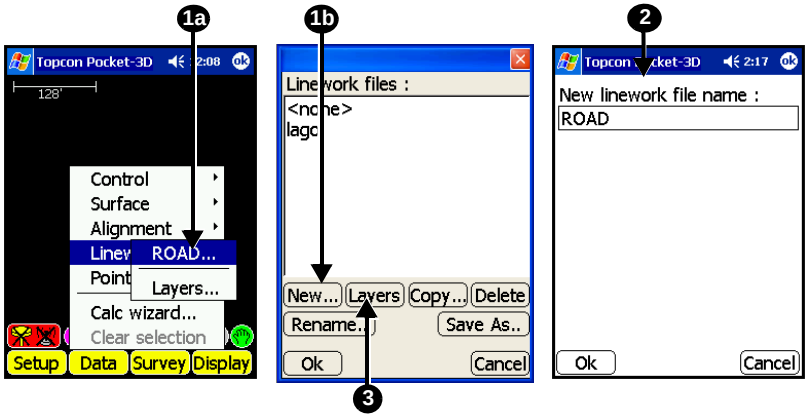


Figure B-15. Create Linework File

4. Press **New**. Enter a name for the layer and the layer's parameters. Press **Ok** (Figure B-16 on page B-12).
5. Repeat step 4 for any other layers.

6. Press **Ok** to save the file. Press **Yes** to apply the file to the current jobsite.

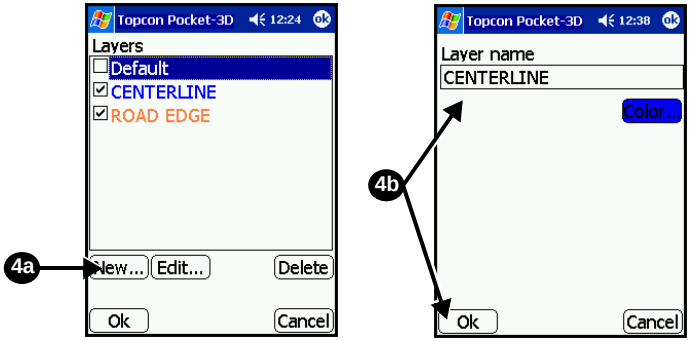


Figure B-16. Add Layers to Linework File

Collecting Data

Pocket-3D can be used to collect points, create polylines, or measure a control point. When collecting data, the project must be localized.

Collecting Points

The following procedure collects individual points (Figure B-17 on page B-13).

1. Tap **Survey** ▸ **Measure pts** ▸ **Topo-shot**.
2. Enter a point number and point descriptor.
3. Select a layer in which to add the point.
4. Press **Ok** to measure the point and return to the main screen.

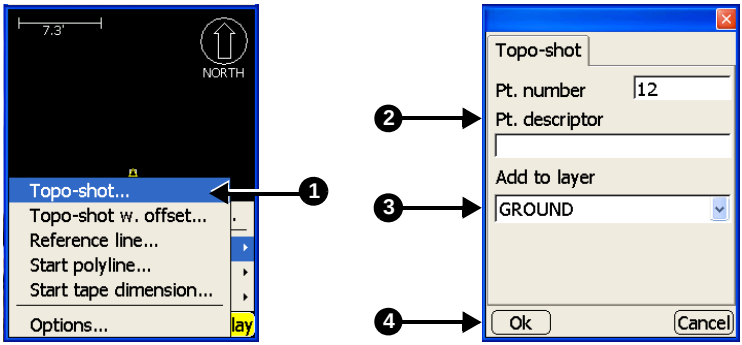


Figure B-17. Measure a Point

Creating Polylines

The following procedure collects points along a line, creating a polyline in a linework layer (Figure B-18 on page B-14).

1. Tap **Survey ▸ Measure pts ▸ Start polyline**.
2. Select a layer in which to add the polyline.
3. Press **Ok** to collect the point.
4. Move to the next point and press the **Enter** button on the controller to collect the next point. Repeat this step for all points in the polyline.
5. At the end of the polyline, tap **Survey ▸ Measure pts ▸ End polyline**.
6. If collecting three or more points to create a closed polygon, tap **Survey ▸ Measure pts ▸ Close polyline** to connect the first and last points.

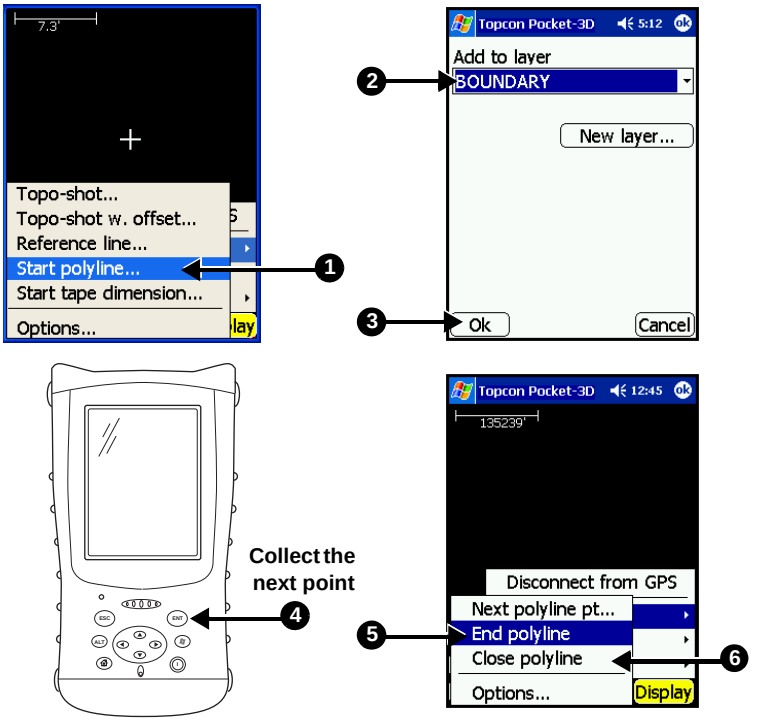


Figure B-18. Collect a Polyline (Using Pocket-3D on an FC-100 Controller)

Performing a Survey

The following procedure is for performing an auto-topo survey based on distance traveled (Figure B-19 on page B-15).

1. Tap **Survey** ▸ **Auto-topo** ▸ **By distance**.
2. Enter a minimum distance for measuring points and select a method to check the distance between points.
3. Select a layer in which to add the surveyed points and enter a point number to start with. If desired, enter a point descriptor.
4. Press **Start** to collect the first point.
5. Travel in a regular pattern to survey the desired area.
6. When done, tap **Survey** ▸ **Stop auto-topo**.

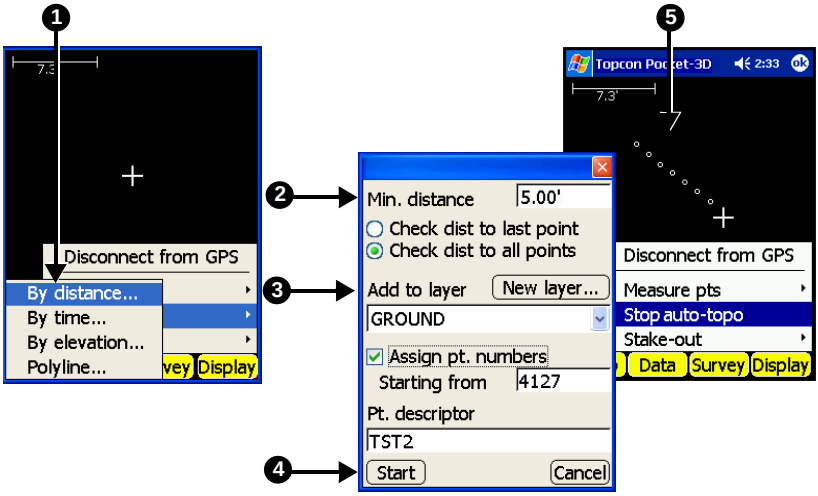


Figure B-19. Perform an Auto-topo Survey by Distance

Performing a Stakeout

Among the most common stakeouts performed with Pocket-3D are point and surface check stakeouts.

Staking out Points

1. Tap **Survey ▸ Stake-out ▸ Point list**.
2. Select the layer and the point to stakeout. Press **Ok**. If needed, travel to the point using the main screen directions.
3. Position the Rover at the point and tap **Survey ▸ Stake-out ▸ Measure stake**. After measuring the point, view the results.
4. To stakeout the next point in the list, press **Next** (Figure B-20 on page B-16).

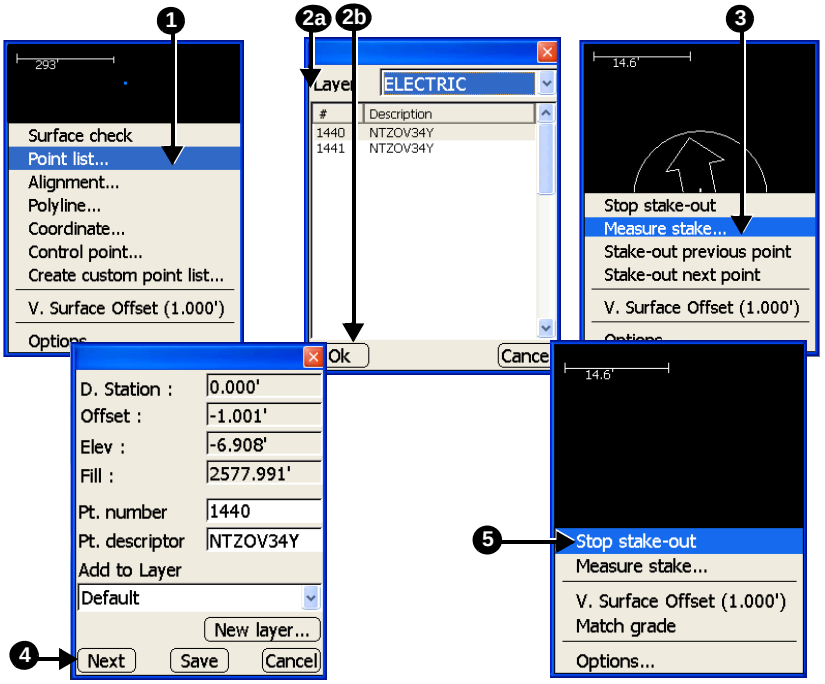


Figure B-20. Stakeout Point

5. To stop the stakeout, press **Ok** and tap **Survey ▸ Stakeout ▸ Stop stake-out** (Figure B-20).

Checking the Surface

1. Tap **Survey** ▸ **Stake-out** ▸ **Surface check** (Figure B-21).
2. View the cut or fill and current elevation.
3. Tap **Survey** ▸ **Stake-out** ▸ **Stop stake-out**.

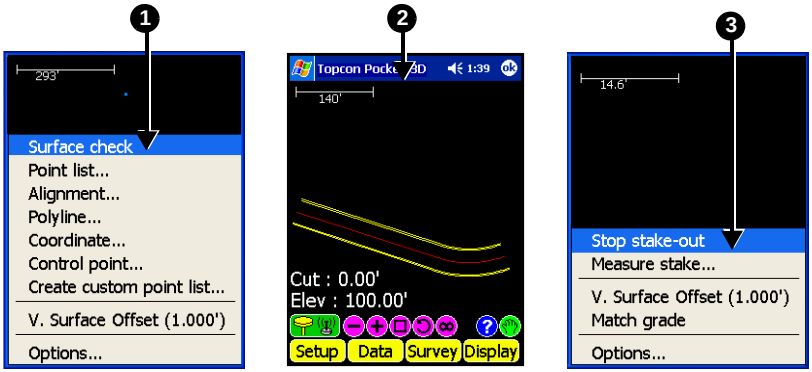


Figure B-21. Perform a Surface Check

Calculating the Inverse Between Two Points

An inverse calculation in Pocket-3D calculates the opposite direction and distance between two points (Figure B-22 on page B-18).

1. Tap the Selection Window icon and drag a selection box around two points.
2. Tap **Survey** ▸ **Calc wizard**.
3. With "Inverse between two pts" selected, press **Next**. The results of the calculation display.
4. Press **Cancel** to exit the ***results*** screen.
5. Tap **Survey** ▸ **Clear selection**.

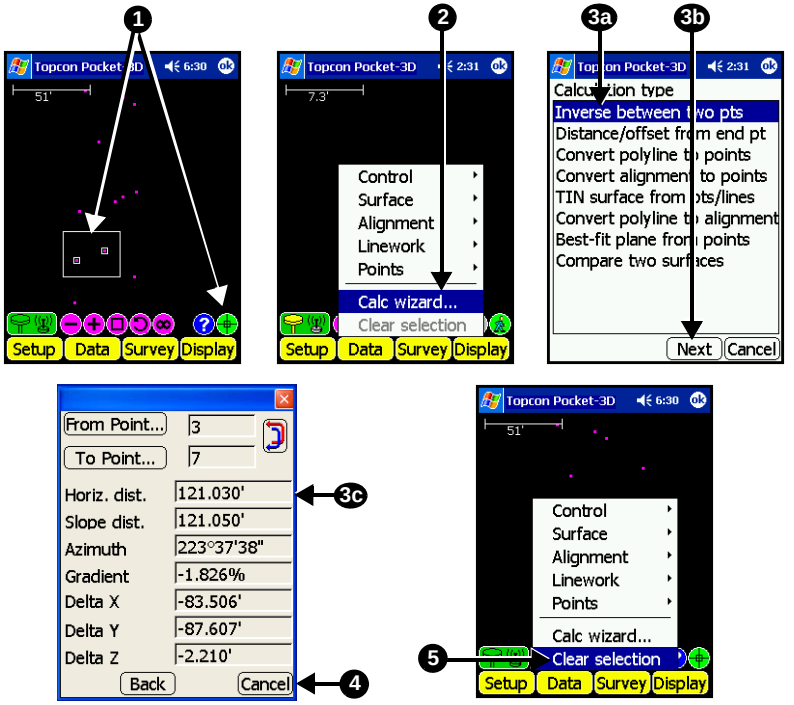


Figure B-22. Perform an Inverse Calculation

Safety Information

You are responsible for becoming completely familiar with the cautions described in this manual. These messages advise against the use of specific methods or procedures which can result in personal injury, damage to the equipment, or unsafe operating conditions. Remember, most accidents are caused by failure to observe basic safety precautions.

General Precautions

1. Read and become familiar with the machine manufacturer's operating instructions, including safety information, before installing or using your Topcon equipment.
2. Use extreme caution on the jobsite. Working around heavy construction equipment can be dangerous.
3. DO NOT attach 3Dxi brackets or hose connections while the machine is running.
4. DO NOT allow any 3Dxi component to limit the visibility of the operator.
5. Use Ty-wraps, supplied with 3Dxi, to keep hoses and wires secured and away from possible wear or pinch points.
6. Use eye protection whenever welding, cutting or grinding is being done on the machine.

7. Protect yourself at all times, and wear protective clothing, when working on or near hydraulic lines. Hydraulic lines can be under extreme pressure, even when the machine is turned off.

Relieve all pressure in the hydraulic lines before disconnecting or removing any lines, fittings or related components. If injury does occur, seek medical assistance immediately.

8. Use appropriate welding precautions and practices when welding. After welding, paint all affected areas with a rust inhibitor.

DO NOT weld near hydraulic lines or on any equipment when in operation.

Disconnect all Topcon system electrical cables prior to welding on the machine.

All mounting bracket welds must be secure and strong to prevent the sensor equipment from vibrating excessively or from becoming detached at the weld during operation.

9. To prevent vandalism or theft, do not leave removable Topcon components on the machine at night. Remove the components each evening and store appropriately in the Carrying Case.
10. Keep the Carrying Case dry at all times.

DO NOT allow moisture to get inside the case. Moisture trapped in the case can adversely affect components.

If moisture does enter the Carrying Case, leave it open and allow it to dry thoroughly before storing any components.

General Usage Warnings

If any 3Dxi component has been dropped, altered, transported or shipped without proper packaging, or otherwise treated without care, erroneous measurements, calculations, or display may occur.

Periodically test 3Dxi components to ensure accurate measurements and operation.

Inform TPS immediately if any product does not function properly.

Only allow authorized TPS warranty service centers to service or repair this product.

The touch screen and LCD on the GX-60 can be damaged if struck with sufficient force.

Base Station Precautions

TPS receivers are designed for machine control, survey, and survey related uses (that is, surveying coordinates, distances, angles and depths, and recording such measurements). This product should never be used:

- Without the user thoroughly understanding this manual.
- After disabling safety systems or altering the product.
- With unauthorized accessories.
- Without proper safeguards at the survey site.
- Contrary to applicable laws, rules, and regulations.

TPS receivers should never be used in dangerous environments. Use in rain or snow for a limited period is permitted.

Internal Battery Pack Warnings

For the Base Station or MC-2.5 Receiver Box:

Tampering with the internal batteries by end users or non-factory authorized technicians will void the receiver's warranty.

- Do not attempt to open the battery pack or replace it.
- Do not disassemble the battery pack.
- Do not charge in conditions different than specified.
- Do not use other than the specified battery charger.
- Do not short circuit.
- Do not crush or modify.

Never attempt to open the receiver's casing or replace the batteries! Lithium-Ion batteries can be dangerous if mishandled!

Do not incinerate or heat battery pack above 212 degrees fahrenheit (100 degrees celsius). Excessive heat can cause serious damage and possible explosion.

Notes:

Specifications

The sections in this appendix give the features and specifications for several of the physical components of 3Dxi™.

GX-60 Control Box

The GX-60 control box is the interface to the sensors, radio, and GPS antenna. Table D-1 lists specification details for the control box.

Table D-1. GX-60 Control Box Specifications

Housing	Cast aluminum
Weight	6 lb. (2.72 kg)
Display	VGA touch screen Color display with adjustable backlight and enhanced brightness 640 x 480
Supply Voltage	10 to 30 VDC
Operating Current	Typical: 3A at 10VDC with no peripheral equipment Maximum: 8A at 10VDC
Operating Temperature	-20° to +60°C (4° to 140° F)
Ports	USB (2) Ethernet (one port routed to two connectors) RS-485 RS-232 CAN (2) Digital inputs (2) Bluetooth (internal)

Table D-1. GX-60 Control Box Specifications (Continued)

Connectors	Two 19 socket MIL-C-5015 cylindrical connectors; gold plated contacts; conductive anti-corrosive plated housing
Switches	2 momentary push buttons: one for power on and one for power off
Cooling fans	1 external housing fan 1 internal processor fan
Operating System	Microsoft Windows® XP, embedded

Figure D-1 shows the GX-60 control box dimensions.

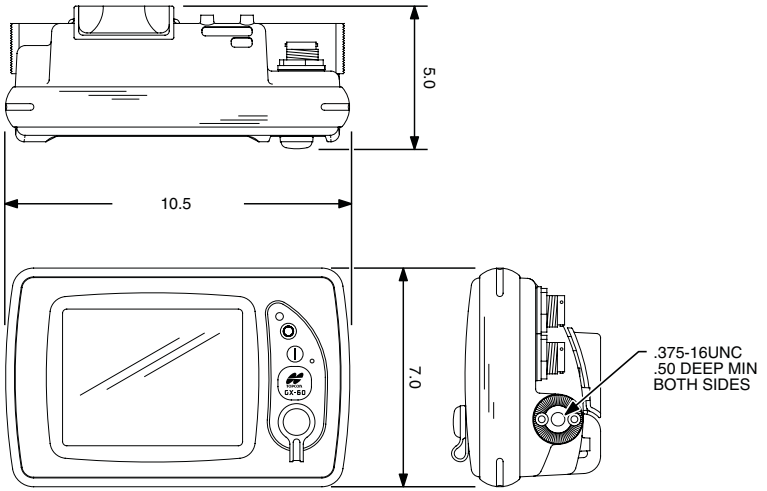


Figure D-1. GX-60 Control Box Dimensions

MC-2.5 Receiver Box

The Rover GPS MC-2.5 Receiver Box provides the industry's most advanced GPS and GLONASS (GPS+) dual-frequency satellite tracking system in a heavy-duty construction design with a shock absorbing mounting bracket. Four, high-power, bottom mounted magnets keep the receiver in place on machine. The receiver also features compliance with CMR and RTCM industry standards and has optional advanced multipath mitigation and optional in-band interference rejection.

Table D-2 lists specification details for the MC-2.5 Receiver Box.

Table D-2. MC-2.5 Receiver Box Specifications

Housing	Cast aluminum
Ports	3 each hardware-controller RS232C
Connectors	2 each 8 soc bayonet (with dustcaps) 3 each 11 soc bayonet (2 with dustcaps) 2 each N female 1 each reverse-TNC female
LEDs	Three LEDs: Radio transmission (red for no signal; green for signal); Two satellite status lights for Main and Aux (green for GPS)
Function buttons	Two function (FN) keys for switching information modes at the Main and Aux boards
Supply Voltage	10 to 30 VDC
Operating Current	10A max
Operating Temperature	0°C to +55°C
Weight	12.10 lb. (5.5 kg)
Radio	Built in UHF or Spread Spectrum
Radio Frequency Band	UHF 450 to 470 MHz Spread Spectrum 915

Figure D-2 shows the Machine GPS Receiver Box dimensions.

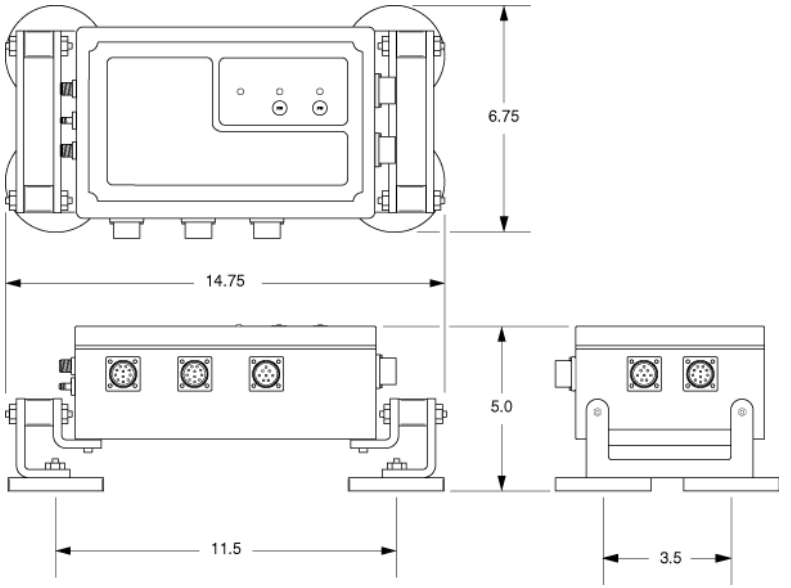


Figure D-2. MC-2.5 Receiver Box Dimensions

MC-A1 GPS Antenna (Machine)

The MC-A1 GPS Antenna is specifically designed with environmental sealing and shock isolation for use on the machine's blade. Table D-3 lists specification details for the MC-A1 GPS Antenna.

Table D-3. MC-A1 GPS Antenna Specifications

Supply Voltage	2.7–12VDC
Antenna Type	Zero-centered flat round plane
Housing	Aluminum ground plane and plastic dome
Connectors	N female
Mounting Clamp	ID 1.75 in
Mounting Thread	5/8 - 11 in

Table D-3. MC-A1 GPS Antenna Specifications (Continued)

Weight	1.9 lbs
Operating temperature	-20°C to +60°C
Phase Center Vertical Offsets	L1: 54.3mm L2: 60.5mm

Figure D-3 shows the dimensions of the MC-A1 GPS Antenna.

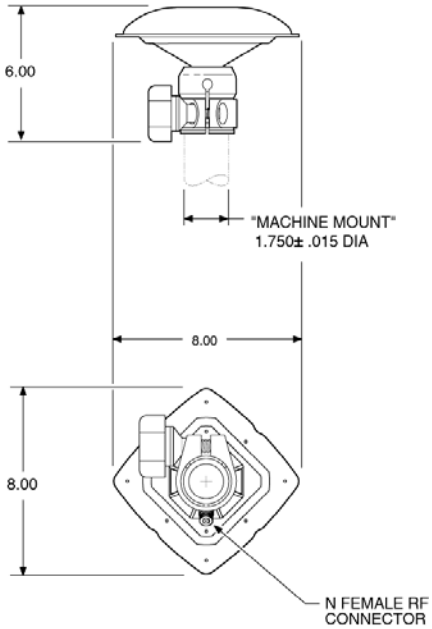


Figure D-3. MC-A1 GPS Antenna Dimensions

Notes:

Regulatory Information

The following sections provide information on this product's compliance with government regulations for use.

Radio Usage Information

All users must obtain an FCC (Federal Communications Commission) license before operating the GPS+ or GPS system (GPS RTK (Real-Time Kinematic) or simultaneous calculation of Global Positioning System and Global Navigation Satellite System).

- **The Federal Communications Commission is at:**

  http://www.fcc.gov/

- **The rules are at:**

  http://www.access.gpo.gov/nara/cfr/waisidx_00/47cfr90_00.html

There have been many problems in the past with RTK base radio modems interfering with voice users. The issue finally culminated with the FCC refusing to grant licenses until something was done to ensure that surveyors did not interfere with voice users. The solution was to stop using frequencies in the 469MHz range, to add an identifier to the broadcast message, and other measures designed to minimize interference with voice users. The user and his employer are subject to fines of up to $82,500, confiscation of surveying equipment and legal action, if the rules are ignored.

Topcon cannot obtain the license for the user. There are companies to assist with licensing. Two are listed here:

- **Professional Licensing Consultants Inc.**

  P.O. Box 1714
  Rockville, MD 20849-1714

- **Atlas License Company and Data Services**

  1725-A North Shadeland Avenue
  Indianapolis, IN 46219

  http://www.alcds.com/

WEEE Directive

Following information is for EU-member states only:

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about the take-back and recycling of this product, please contact your supplier where you purchased the product or consult.

Warranty Terms

TPS laser and electronic positioning equipment are guaranteed against defective material and workmanship under normal use and application consistent with this Manual. The equipment is guaranteed for the period indicated, on the warranty card accompanying the product, starting from the date that the product is sold to the original purchaser by TPS' Authorized Dealers.[1]

During the warranty period, TPS will, at its option, repair or replace this product at no additional charge. Repair parts and replacement products will be furnished on an exchange basis and will be either reconditioned or new. This limited warranty does not include service to repair damage to the product resulting from an accident, disaster, misuses, abuse or modification of the product.

Warranty service may be obtained from an authorized TPS warranty service dealer. If this product is delivered by mail, purchaser agrees to insure the product or assume the risk of loss or damage in transit, to prepay shipping charges to the warranty service location and to use the original shipping container or equivalent. A letter should accompany the package furnishing a description of the problem and/or defect.

The purchaser's sole remedy shall be replacement as provided above. In no event shall TPS be liable for any damages or other claim including any claim for lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, the product.

1. The warranty against defects in Topcon batteries, chargers, or cables is 90 days.

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